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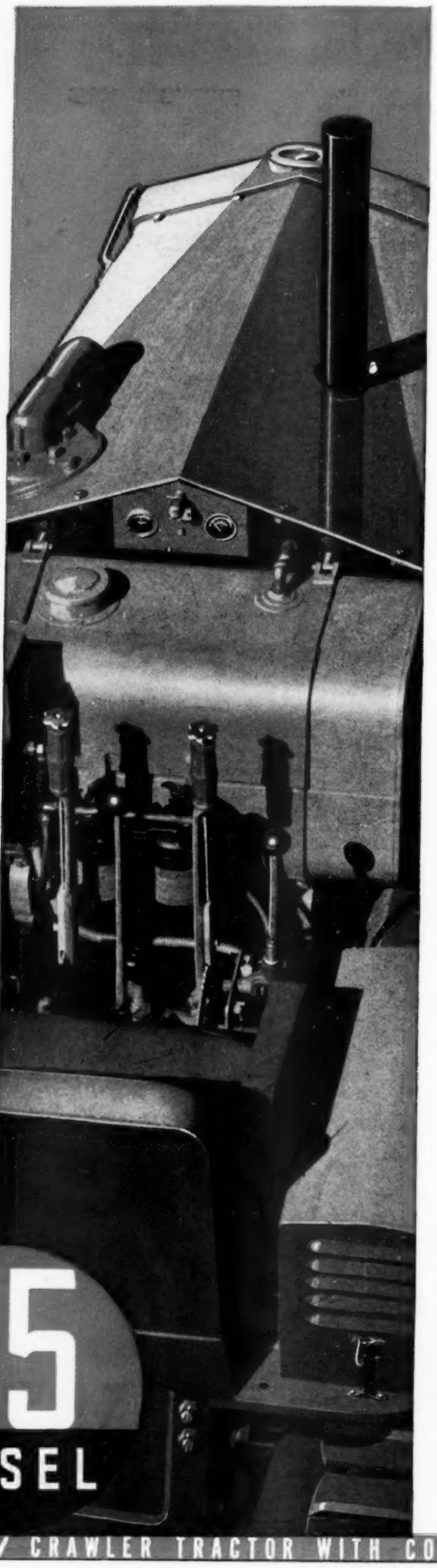

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VOL. 65 PUBLIC WORKS No. 10

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OCTOBER, 1934

October 1934

PUBLIC WORKS

Vol. 65 No. 10

CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

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TIMEWASTERS

We want to apologize to our old friend and long-time coworker in the job of educating young Boars at Carlisle, Major F. E. Daniels. We did not mean to say, in our September dissertation, that he was wrong in working out the pyramid problem with nothing but a saw, but we meant we couldn't do it. However, there doesn't seem any doubt to us, but that if the block is beveled to 45° on the bottom, and then cut at a 45° angle while held also at a 45° angle, the resulting bevel will be the correct one. Most everyone agrees it is 30° though one or two earnest seekers after truth still feel it may be something else.

The fire truck problem and the big-board-in-the-little room problem have sort of slowed down some of the sharks; or maybe they are still on their vacations. B. Eisner contributes the beautifully executed solution to the first-mentioned problem, which will be found on page 53. Robert R. Hoops, from Ohio, also contributes a masterpiece on the same problem, using Sturm's Theorem and Horner's method of approximation. Well, we're glad to know there are such tools, but personally we are not well acquainted with them. Mr. Hoops says the final OK is 10.43932 feet.

Ed Wynn did not respond to our call on that fire truck problem, Bob Clark being the only one to come across. He says the spacing should be 560 feet, but that he'd hate to be the driver, because it takes mighty close shaving. What is the pleasure of the mathematic experts? Is Mr. Clark correct in his figures?

The Town Clock:

The old town clock has gone haywire. Each hour it slows down by exactly one minute. If it keeps going without resetting, how long is it between intervals of truth-telling? Contributed by *Benjamin Eisner.*

Mikey & Ikey at Old Orchard:

One night Mikey, who is fat and just 6 feet tall, chased Ikey, who is a little runt, in a straight line along Old Orchard Beach, which is level. They started under an arc light. The highest speed Mikey could work up to was 4 miles an hour, and as the chase went on, Ikey's shadow coincided exactly with what the forward part of Mikey's shadow would have been, if Ikey had not been there. What is the rate, in miles per hour, at which the end of Ikey's shadow travels under these distressing circumstances, and also the rate at which the end of Ikey's shadow separated from Mikey? Contributed by *Walter S. Wheeler.*

P. S. They hang their arc lights 10 feet high in Old Orchard.

Compass and Straight-Edge, Please:

Given any angle, and any point within the sides of the angle, draw a circle tangent to the sides of the angle and with the circumference passing through the point. Contributed by *R. N. Clark.*

W. A. H.

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A. PRESCOTT FOLWELL, *Editor* — **W. A. HARDENBERGH,** *Asso. Editor*

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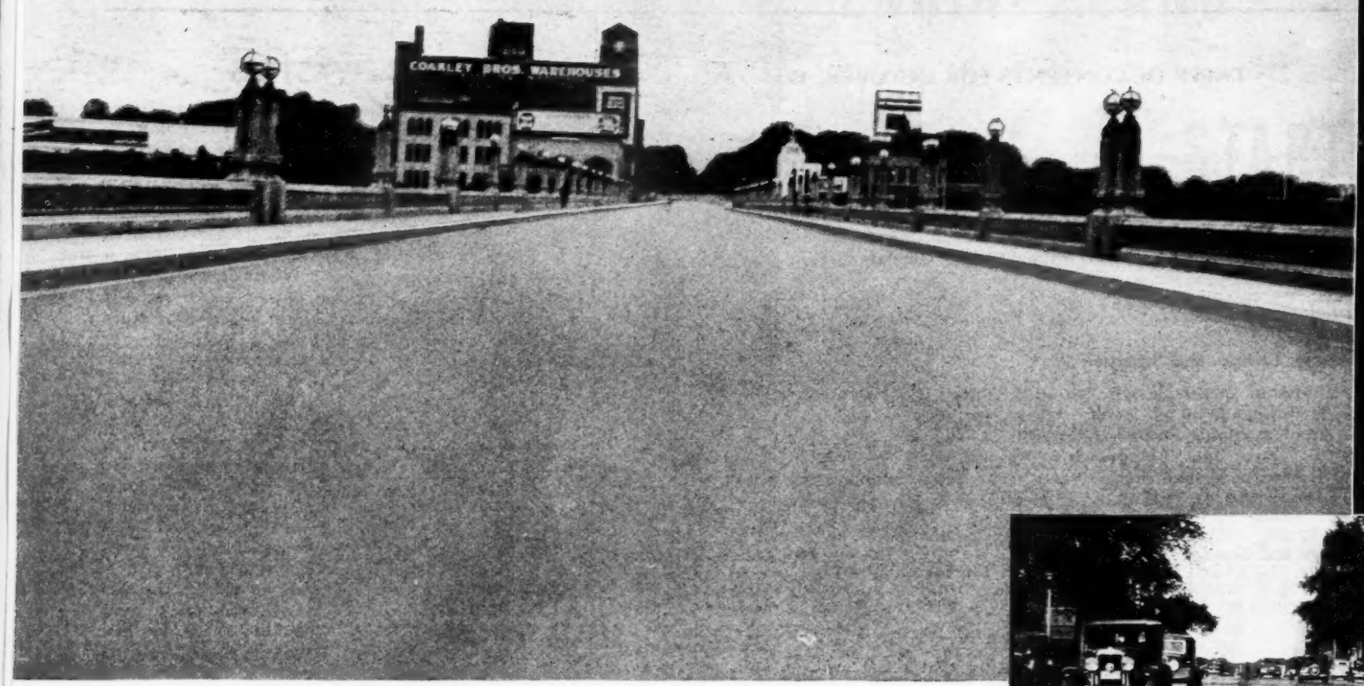

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Stanolind Paving Asphalt recently laid on highway No. 18, Milwaukee, Wis.

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PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 65 — *October, 1934* — No. 10

One Man's Ideas about Street Designing

By D. Y. Bate

PART 1. NECESSARY SURVEYS

This is the first of a series of articles by Mr. Bate discussing some of the problems and details of street design. Readers are invited to contribute their own "kinks" and ideas.

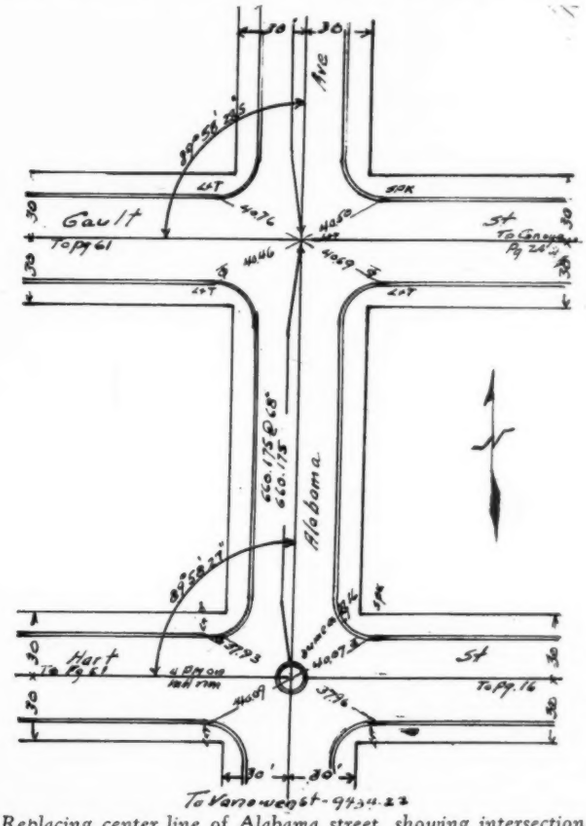
Center Line Surveys

IN THE older street surveys of municipal tracts very few data as to center line location, length or angles were given; however, more recent legal provisions require that center line lengths and bearings be given; also that ties to the property corners be made and recorded and that suitable permanent monuments be set accurately locating the center line and the property lines at all street and alley intersections.

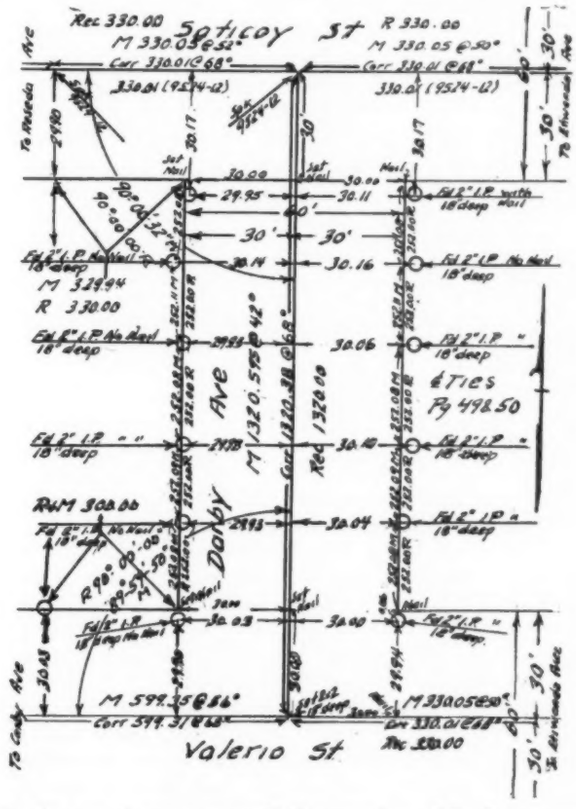
In reestablishing a center line from an old survey, wherein no center line data were given, it is a good policy to calculate a theoretical center line, using such data as are given on the recorded plat and any known ties to established points. From this calculated center line, locate the points of street intersections as given on the recorded plat. After these lines have been run and the points located, an idea may be obtained as to the original location and a search should then be made for any existing monuments which may be on the ground; and if sufficient of these are found, the trial line as run can be corrected to fit the existing monumented layout.

Where an insufficient number of permanent monuments are found, the exterior boundary of the tract should be closed by tying to monuments of adjoining tracts, the survey closed and balanced, then the original survey should be recalculated and adjusted in proportion to the exterior boundary measurements and the original street center line measurements as given on the recorded plat.

An old tract was encountered recently by the writer which had been laid out as a mountain cabin site subdivision in what was then a quite rural district. The



Replacing center line of Alabama street, showing intersection angles, ties of monuments to reference points and other data.



Field notes of survey to establish center line of Darby avenue. Tape standard at 68°.

entire survey had been made in a rather haphazard manner and no permanent monuments set even for the exterior boundaries. Adjoining tracts, however, had been resurveyed and monumented, and from these monuments the exterior boundary was resurveyed and closed. Being unable to find any of the interior stakes, triangulation stations were located at convenient points on the ridges in the interior of the tract. These triangulation points were coordinated with the exterior boundary. The center lines of the various streets were then calculated, coordinated and adjusted proportionally to the exterior closure and the original street data as recorded.

All of the streets were excessively curved and the tangents were too short to allow for any accurate rerun of the lines as a continuous line, so that the points of intersection of all tangents were tied to triangulation points by azimuth and distance, these points of intersection set, and the curves run from them.

A separate plat should be made of the center line survey on which all possible data should be shown, including intersection angles of all streets and alleys, ties and distances to reference points for all monuments set (these data should be very complete and clear), distances between monuments, distances to property corners, old monuments found, and any other data that may be of information or use to anyone who may in the future wish to replace the lines or any parts of them. Paper and pencils are cheaper than survey parties, and any data that have any bearing on the line should be recorded in clear, concise form and NOT CROWDED.

Topographical and Profile Surveys

From points established by the center line survey, the side or property lines are laid out by offset from the center line. All topographical features also are located by stationing and offset from center line. A plat should be made in the note book (not necessarily to scale) on which all important features are shown, including fences (kind and height), washes and ditches, buildings, (giving size, height and material of construction), culverts (size and material of construction), and trees by name and size. Where an excessive number of trees are encountered and their location would make the plat hard to read, they may be omitted from the plat but a schedule may be made of the station and offset, the size, and kind of each. All poles should be properly located and described so that the proper public utility corporation may be notified should their removal be necessary; all manholes, meters, fire hydrants and any substructure data available should also be gotten.

A good way to be sure that you are giving complete data on your plat is to take the attitude, "have I given enough data so that this particular point may be easily and intelligently located by someone who has never seen this locality?" Make your plat large enough so that your figures are plain and nothing is cramped or crowded, because notes that are not clear and legible are often the cause of a resurvey being requested or additional data obtained. A few extra pages in your note book so that the plat may be plain and not crowded are much cheaper than the cost of a party to return and get more data or clear up some figure that is not plain and clear due to crowding of your plat.

If the street being profiled is of over a half-mile in length, precise levels should be run and bench marks established at intervals of not to exceed one thousand feet. These precise levels should be tied to a known bench mark that has been established by precise levels.

After establishment of the bench marks, profile levels are then run, taking sufficient cross-sections to enable a complete picture to be drawn of the terrain; being sure to give elevations of all man-made improvements within the dedicated street and on any improvement outside of it which will have any bearing on the proper design of a street. Driveway aprons and garage entrances and floors, if adjacent to the street lines, are important so that grades may be laid to afford convenient entrance to them; also steps to porches and terraces; existing walks and curbs; flow lines and tops of culverts; any indication of high water marks; all data possible on existing bridges; driveway data sufficient to allow for making a smooth surface and easy driving should any change be made in the existing grade; and any other features that may have any bearing on a proper design.

Elevations of bench marks and turning points should be run to thousandths, improvement elevations to hundredths, and ground elevations to the nearest tenth. All levels should be reduced and references to center line data from which this survey was run should be shown on the plat.

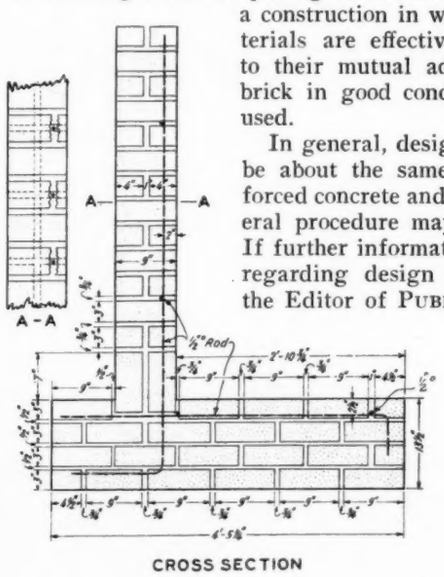
Do not leave the job until you are sure you have obtained all possible data that is pertinent to it. Where improved streets intersect the street being profiled, it is a good idea to take a few shots up it, sufficient to establish its gradients and also to note the class of surfacing and condition.

Reinforced Brick Retaining Wall

A retaining wall of reinforced paving brick was constructed in Canton, O., last year, bids having been received on this material in competition with reinforced concrete. The elimination of form work and the reduction in the amount of excavation necessary under many conditions, often combine to produce a very cheap wall, so far as construction costs are concerned.

When correctly designed the introduction of reinforcing bars into masonry of paving brick utilizes to the greatest possible extent the full crushing strength of the individual paving bricks. The combination of reinforcing steel and paving brick masonry results in a construction in which both materials are effectively combined to their mutual advantage. Old brick in good condition may be used.

In general, design factors will be about the same as for reinforced concrete and the same general procedure may be adopted. If further information is desired regarding design details, write the Editor of PUBLIC WORKS.



Reinforced Paving Brick Retaining Wall.

Hinton's Finances Pictographically Shown

THE city manager of Hinton, W. Va., Hume K. Nowlan, publishes every few weeks a bulletin that we feel sure all the taxpayers and voters of the city read—we do not see how they can help it, for not only is it written so as to give, in easily grasped sentences, information of value to them, but it is illustrated by drawings and cartoons that compel attention. The one issued September 3rd dealt with the cost of operating the city government. We have grouped the drawings (reduced in size) and condensed the text about 50% to permit reproducing them. The citizens of this city of 7,000 population should appreciate this enterprise of their city manager, especially as the Bulletins are printed on a duplicating machine—in the city manager's office, we suppose—and the cost to them is nominal. What it costs Mr. Nowlan and his assistants in grey matter is something for which we hope they receive credit in public approval.

The general statements which the drawings illustrate are (somewhat condensed) as follows:

The budget appropriations for operating the city government in 1910, 1920 and 1934 show a 3% increase in the former period but a 71%, during the latter.

It is admitted that the evidence against the incumbent administration is very damaging at first glance—but it is also contended that the first glance should not be the last one. Perhaps there are valid reasons for 71%, or even greater, increases.

The increase in area from ¾ of a square mile in 1920 to 5½ square miles in 1934 represents an expansion of 633%. It is an important factor because it enters into the cost of practically all municipal services, including such major items as street mileage.

While street mileage did not keep pace with area increase, a change from 9¾ to 21 miles represents 115% more work to be done today than was necessary in 1920.

The 77 feeble street lights of 1920 appear no brighter in comparison with the present 171 brilliant lamps than they did in actuality back in what could now be facetiously referred to as the "dark ages" of 14 years ago. In number, street lights increased 122%; in illuminating power, more than 400% due to increase from 50 and 60 to 250 and 400 candle-power units.

The 65% increase in fire hydrants fails to express the true expansion of water service because it simply compares the present 76 fire hydrants with the 46 of a decade ago. What actually happened was that mains were shoved outward and service and protection extended into new territory—305% in excess of that afforded in 1920.

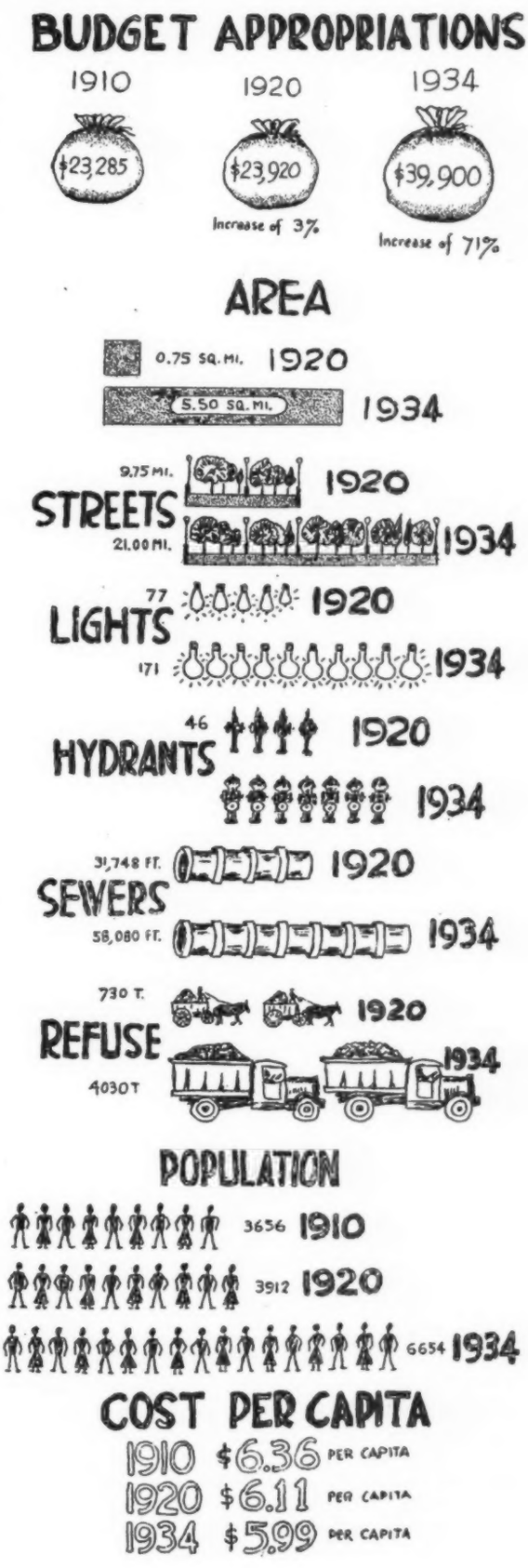
The addition of nearly 5 miles of sewer lines to the city system in the past 14 years represents 83% more footage to be periodically cleaned and constantly maintained.

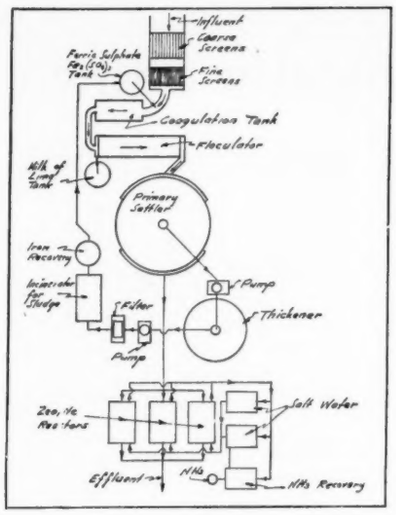
Where the city moved only 730 tons of trash in 1920, and did it by simply unloading the refuse on an unsightly and unhealthy open dump, 4030 tons were handled last year—practically all at the 17th Avenue incinerator. This is an increase of 452% since 1920.

In addition, there have been extensive improvements in public works, finance, public health, welfare, parks, playgrounds, markets, public buildings, zoning and planning, as well as increased facilities for fire protection and public safety. All these things cost money and it is only reasonable to expect that, if volume or quality has been increased, a corresponding rise in expenses will have resulted.

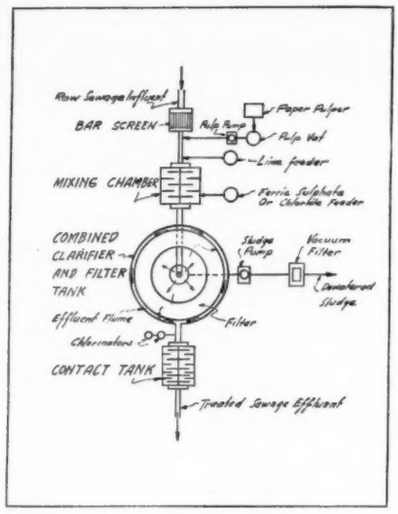
Population increase is a determining factor. Here again we find very little change from 1910 to 1920—but a marked increase from 1920 to 1934. The spurt in population amounts to 70% during the latter period.

But the actual volume of work performed, due to improved service rendered, increased more than 200% during those 14 years. In spite of which, we find that operating our city government costs less now per capita than it did back in the "good old days" of 1910 and 1920. The actual figures were $6.11 in 1920 and $5.99 in 1934.

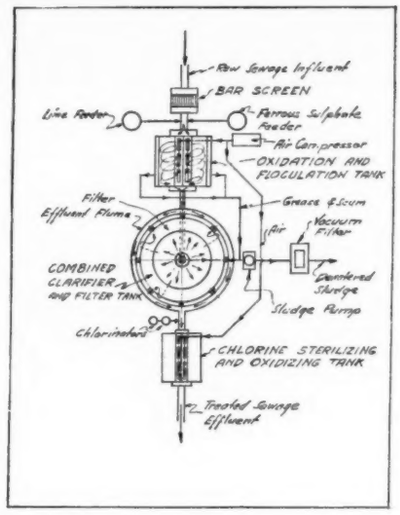




GUGGENHEIM PROCESS



LAUGHLIN PROCESS



STREANDER PROCESS

Flow diagrams of chemical treatment processes.

The drawings used in this article were prepared by P. B. Streander and kindly loaned by him.

Most Recent Developments in the Chemical Treatment of Sewage

By M. J. Blew
Research Engineer, Philadelphia, Pa.

CHEMICALS were used extensively in sewage treatment prior to the general adoption of biological treatment. Hundreds of patents were issued for the use of various materials, such as alum, blood, clay and others (the "ABC process"), and Holden's compound (iron sulphate, lime and coal dust), but lime precipitation was for years the chief method. In 1883 a British patent was issued for purifying wastes and sewage by use of ferric chloride, lime, and cellulose or paper pulp, followed by precipitation and filtration. The Degener process in Germany involved the mixture of lignite with the sewage, precipitation with ferric sulphate and treatment with bleaching powder. Adeney suggested adding to the sewage oxanite (a crude sulphate of manganese mixed with the higher oxide of that element) for precipitation, and nitrate of soda to stabilize the effluent.

In the older and some of the more recent methods, while the addition of large amounts of lime, raising the pH of the effluent to 10 or 11, causes a retarding of the natural oxidation of the sewage, dilution with the receiving water so reduces the pH in many cases as to remove the retarding influence, and putrefactive action will again proceed on a much reduced scale. This fact is mentioned because it is not only the physical appearance and favorable initial B.O.D. of the effluent that counts, but the continuance of these conditions after the effluent has been discharged into the receiving water.

With the advent of biological methods, chemical treatment stopped almost entirely, for it was far from being perfectly satisfactory for a number of reasons. Controls were unknown. The chemistry of such treatments was in its infancy. Hydrogen-ion concentration and the physics of colloids were practically unknown. Precipitated sludge was allowed to accumulate in tanks for days and weeks, with eventual septization, and mechanical means for removing it had not been developed. Disposal of the large amount of sludge that resulted was a serious problem, mechanical dewatering equipment falling far short of its present stage of development.

Biological methods seemed to offer a solution to many of these difficulties. They also presented their own problems, but development of technique, a better scientific understanding and rapid accumulation of data tended to make them continuous, brief and without nuisance. But biological methods as now exemplified by the activated sludge process, with high temperature separate sludge digestion, involve complications in operation which can only be handled by highly trained experts; while the capital cost is often many times greater than is necessary to produce an effluent which would satisfy the conditions imposed by the degree of dilution available. The results are often upset by little-known biological phenomena, the unexpected arrival of large quantities of industrial wastes, temperature changes, or extreme variations in sewage flow, particularly during rainy weather. The process is not definitely controllable; and collection and burning of sludge gas introduce undesirable hazards.

Non-biological treatment seemingly offers methods that fill that large field in which the required results lie between those produced by primary and secondary treatment, the operations being adjustable to produce a comparatively wide range of results. With the present appreciation of the mechanism and control of coagulation and flocculation, the advanced knowledge of the physics and chemistry of colloids, and the use of hydrogen-ion in control, the inherent disadvantages of the old order of chemical precipitation have largely been overcome. Such treatment is distinctly controllable, and capable of carrying heavy overloads without upsetting purification results. Where a high degree of purification is required, such as biological treatment

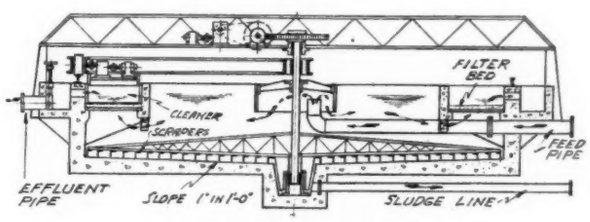
affords, such treatment can be greatly reduced by preliminary non-biological methods, while the sludge-conditioning equipment of the latter can be used for treating the sludge from biological treatment also.

Research work is being carried on to develop and improve chemical treatment. The improvements will to some extent be functional but will mostly consist of controls and equipment for use in the process. At present some fifteen processes are being developed, the principles involved in all being about the same but the means of accomplishment varying. They include the use of chemical coagulants, insoluble solids and materials for removing dissolved organic matter. Among the coagulants used are ferric chloride and ferric sulphate, ferrous sulphate, alum, sodium aluminate, copper sulphate, chlorine and lime. Insoluble solids include paper pulp, marl, cement dust, returned sludge and ground charred sludge. Some of the processes include filtration of the sewage through various types of sand, coal or special medium filters. The use of zeolite filters for the removal of ammonia is proposed under one of the processes, and the use of chlorine to fix or precipitate organic matter and as a further oxidizing and sterilizing agent is a part of some of them.

Probably the most outstanding accomplishment in the field of chemical treatment is the adapting of special mechanical equipment to special chemical processes.

Brief descriptions of several of the processes referred to are given herewith.

Laughlin Process—Plant in operation for two years at Dearborn, Mich., capacity 30 mgd. Process: (1) Add ferric chloride, or ferric sulphate and lime, to the raw sewage. Also paper pulp,



Laughlin Clarifier and Filter

which improves filterability and accelerates rate of filtration, and is claimed to accelerate rate of settling of coagulated solids.

(2) Coagulated solids removed by combined settling and filtering tank, radial flow type, detention period 1½ to 2 hrs. Upward flow filter, annular in plan, attached inside the outer wall of tank, comprises 2" or 3" of crushed, screened and sized iron ore resting on a bottom of screens and plates. Floc, retained under this "magnetite sand," is washed out by a pulsating magnet which continuously traverses the entire filter surface, lifting the sand. Nominal rate of filtration, 1½ to 2½ gpm per sq. ft.

(3) Settled sludge removed from tank mechanically, conditioned, and dewatered on vacuum filters.

(4) Effluent oxidized and sterilized with chlorine.

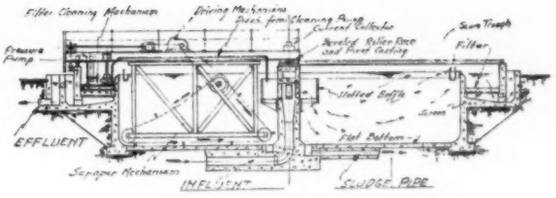
Guggenheim Process—Demonstrated at 2,500 gpd plant in New York City and 25,000 gpd experimental plant in Chicago. Process: (1) Raw screened sewage is coagulated with ferric sulphate, with air agitation to keep iron in ferric condition; followed by lime to give dense, rapidly settlable floc.

(2) Coagulated solids settle in clarifier, removed mechanically and dewatered on vacuum filter, and burned in rotary kiln incinerator. Ash from incinerator treated with sulphuric acid to regenerate ferric sulphate, which is re-used for coagulation.

(3) Effluent from clarifier passes through zeolite reactor bed in which the sodium ions replace the ammonia nitrogen groups, which, when the zeolite is regenerated with salt water, are removed in that water and are recovered from it by addition of lime to release the amines, which in turn are recovered by distillation and condensation.

Lewis Process—Under experimental operation in 500,000 gpd plant at Atlanta, Ga. Process: (1) Ferric chloride and lime are added to raw screened sewage, followed by ferrous sulphate and "Cotrell" dust (cement dust). A pH of 10.0 to 10.5 maintained throughout the process is the controlling feature.

(2) Coagulated solids removed from settling tanks mechanically, and dried on sludge beds, or can be dewatered on vacuum filters.



Streander "Hy-Speed" Clarifier and Filter

Stevenson Process—Experimental plant, 36,000 gpd capacity, constructed at Palo Alto, Calif., by Great Western Electro-Chemical Co. Process: (1) Screened sewage detained 2½ hrs. in primary settling tank, then ferric chloride is added in a two-stage mixing tank (no lime used), and coagulated solids settle in secondary settling tank with 1½ hrs. detention period.

(2) Chemical sludge from secondary tank is returned to and mixed with raw sewage entering the primary tank.

(3) Sludge from primary tank digested in separate tanks, or conditioned and dewatered on vacuum filters.

Streander Process—Experimental plant, 25,000 gpd capacity, operated 18 months at Philadelphia Northwest Sewage Works; sewage contains grease and trade wastes. Process: Ferrous sulphate and lime added to raw screened sewage in a flocculation tank, forming at once ferrous hydroxide which readily absorbs oxygen; which air blown through the mixture plus absorption of atmospheric oxygen converts to ferric hydroxide, prevents return to the ferrous form and satisfies immediate oxygen demand of the sewage liquor.

(2) In circular, radial-flow, settling tank, 1½ to 2 hrs. detention period, solids settle and effluent flows to a submerged filter bed annular in plan, surrounding the tank and constructed integral with it. Filtering rate, 1½ to 2½ gpm per sq. ft. filter area. Filter medium, 9" of sand or anthracite coal supported on a screen and plate. Retained floc removed by water jet rakes inside a cleaning caisson and returned to raw sewage.

(3) Sludge removed from tank by mechanical scrapers and dewatered on vacuum filters.

(4) Effluent from filter sterilized, and oxidized by introducing chlorine in an air-actuated contact and oxidizing tank.

Where sludge is to be incinerated, Streander proposes modification of process, first removing 30% to 40% of suspended solids by screening bar-screened sewage through revolving coal mat at rate of 40 gpm per sq. ft.; treating effluent in flocculation tank as above; and in settling tank with 1 to 1½ hrs. detention period, and through filters as above; sludge from settling tank being returned to sewage entering the coal mat filter, and all sludge from this filter (with some of the coal) is mechanically dewatered and incinerated in a combined kiln dryer and stationary combustion hearth.

Wright Process—An entirely new principle in mechanical removal of suspended solids developed at activated sludge plant at Rockville Center, N. Y. Process: (1) Clarification of raw sewage in primary settling tank.

(2) Clarified sewage pumped to vacuum filters, pulped paper being added just ahead of the filters and forming the filter mat; pH maintained at optimum for filtration by adding lime.

(3) Vacuum filter effluent goes to aeration tank and then to final settling tank.

(4) Effluent from final tank cleared of fine pin-point floc on other vacuum filters.

(5) All derived sludge is dewatered on vacuum filters, using higher vacuum than for sewage.

(6) Dewatered sludge cake is burned in municipal refuse incinerator.

It is proposed to use the same process without preliminary sedimentation, in which case the raw sewage and pulp are filtered as in (2), but the filter mat is further dewatered on another vacuum filter, bringing the moisture content down to 70-75%.

Landreth Process—(originally termed the Direct Oxidation process), in operation in Winston-Salem, N. C., for about seven years. Uses lime in amounts to secure caustic alkalinity, presumably to condition the sewage for the electrolytical treatment which is the prominent feature of the process.

Cabrera, in a 60,000 gpd experimental plant in Wilmington, Del., uses aluminum sulphate and returns part of the settled sludge to the raw sewage for the further absorption of organic matter.

Travers, in a 500,000 gpd plant in Ashland, O., used ferrous sulphate, lime, marl and aluminum sulphate.

Among other experiments may be mentioned *Downes'* use of ferric sulphate at Plainfield, N. J., to reduce load on sprinkling

filter: *Tatlock's* work on a lime-chlorine process for odor control at Dayton, O.; *Hendon* for the proposed Birmingham, Ala., plant; and the *Diamond Alkali Co.* of Cleveland, O., using ferric chloride, chlorine with or without lime.

Aeration of chemically treated sewage, and mixing previously precipitated sludge with sewage are not new; nor is the addition of wood pulp. In 1883 Johannes Bock patented a process consisting of adding "wood pulp or paper fiber," chloride of iron and magnesia, and milk of lime to effect precipitation; the effluent being then run through a "Purvey trough filter" to remove the last trace of suspended particles; the patent also including return of previously settled precipitate and its admixture with incoming raw sewage to reduce the amount of fibrous material, iron and lime needed. In 1914-1916 Rice advocated a process in which sufficient lime was added to screened raw sewage to secure caustic alkalinity and it was then mixed with previously settled sludge in a tank and agitated by circulation and induced aeration. Caustic soda was then added and mixed, the sludge settled and the effluent was passed through a sand filter.

Results Secured

Sufficient time has not elapsed to secure clear and definite operating results and cost data. From reported results, the reductions in suspended solids and B. O. D. are as follows:

	Reduction in per cent		
Process	*Suspended Solids*	*5-day B.O.D.*	*pH range*
Laughlin			
Dearborn, Mich.	91	68	7.5 to 9.1
Coney Island, N. Y. .	84	69	9.0 to 10.3
Guggenheim			
New York City	95	95	6.0 to 8.0
Chicago, Ill.	95	90	
Lewis			
Atlanta, Ga.	76	77	10.0 to 10.8
Stevenson			
Palo Alto, Calif.	84	60	6.8 to 7.4
Streander			
Philadelphia, Pa. 92-95		75-80	8.0 to 8.5
Landreth			
Winston-Salem, N. C.	87	88	
Chicago, Ill.		66-72	
Travers			
Ashland, Ohio	85	50	
Cabrera			
Wilmington, Del.	89	78	

There appears to be ample evidence that the known processes, involving chemical precipitation in one form or another, will produce a degree of treatment equal to a reduction in bio-chemical oxygen demand of between 60 and 75 per cent. When followed by rapid filtration, the appearance of the effluent is materially improved and in addition, the B. O. D. reduction will amount to between 70 and 85 percent. The Guggenheim process produces results well comparable to the performance of the better operated activated sludge plants, but at increased operating cost.

Operating Costs

The data covering costs of operation of chemical sewage treatment plants on normal sewage, are as yet meager and somewhat unconvincing. They range from as low a figure as $6 to as high as $45 per million gallons. Comparative costs are somewhat difficult to analyze, as the character of the water used, the presence of industrial wastes, the pH of the raw sewage, etc., all have a very direct bearing on the quantity of chemicals required and, consequently, the cost of treatment. Streander in Philadelphia, using the inexpensive ferrous sulphate and lime, with air flocculation and oxidation for a period of twenty to thirty minutes, reports the cost of chemicals and power for compressed air to be as low as $6 per million gallons. Operating costs for the Laughlin process, based on operating tests at Dearborn and Coney Island, using paper pulp, lime and ferric chloride, show chemical costs at about $8 or $9 per million gallons. At Atlanta, the tests on the Lewis process gave chemical and cement dust costs at about $12 per million gallons. Total operating costs, including chemicals, power, labor, repairs, maintenance, etc., but not including fixed charges, will probably range between $8 and $20 per million gallons, depending upon the size of the plant and the method of treatment used.

Construction Costs

Construction costs vary to a great extent, depending on the method of treatment used and the treatment and disposal of the derived sludge. The size of the plant, or its capacity, also has a decided bearing on the cost of construction. Generally the cost should range between $50,000 and $100,000 per million gallons.

Akron's Sludge as a Fertilizer

AKRON, Ohio, since its Betzum sewage treatment plant began operation, has given away plain precipitated sludge dried on sand beds. To determine its value for truck garden produce, an experiment was conducted during the summer for 1931, and the results showed that it is of no value for peas, head lettuce, spinach, peppers and cucumbers; doubtful in the case of endive and parsley; of moderate value for Kentucky Wonder beans, onions and cabbage; of real value for curled lettuce, squash, pumpkins, turnips and tomatoes; and of exceptional value for lima and stringless beans, celery, parsnips, beets, radishes, cantaloupes, carrots and sweet corn.

Although it contains approximately 2 per cent nitrogen, 0.5 per cent water soluble potash and 0.6 per cent available phosphoric acid, the sludge is lumpy and therefore difficult to spread evenly, and it was decided to investigate the feasability of preparing it in a ground state for sale as a fertilizer.

Accordingly, a questionnaire was sent to every treatment plant in the United States where sludge is known to be sold in any form. Out of 48 states, 30 were found where either no sludge is sold or no data are available. In the remaining 18 states, 19 plants report the sale of sludge. Of these, there are 14 producing sludge similar to Akron's, 3 activated sludge and 2 chemical precipitation plants. Ohio seems to be more "sludge sale" minded than any other state, with Ashland, Toledo, Medina, Elyria, Marion and Dayton selling, while New York state is second, with 3 plants.

Sludge is sold as it comes from the beds or dried and ground; either direct to the consumer or through jobbers. Reports vary as to whether or not it is advisable to sell sludge. Revenue likewise varies from 25 cents to $11 per ton for sludge similar to Akron's. Total income in 1933, except for activated sludge, runs from $55 to $4814. The two chemical plants reporting received $175 and $200, respectively, in 1933.

The quantity and quality of sludge, the available market, the fluctuations in demand and sale price, the original investment in a fertilizer plant and experiences in other cities all must be taken into consideration before adopting a plan. Under present financial conditions, the only logical conclusion is to move slowly, invest the minimum possible in a grinding and storage plant and to seek the cooperation of the press in advancing the use of the city's sludge, because it does have some fertilizing value as herein cited.

The above information is given in a bulletin issued by the Akron Department of Public Service, prepared by T. C. Schaetzle, engineer-chemist of the sewage treatment plants.

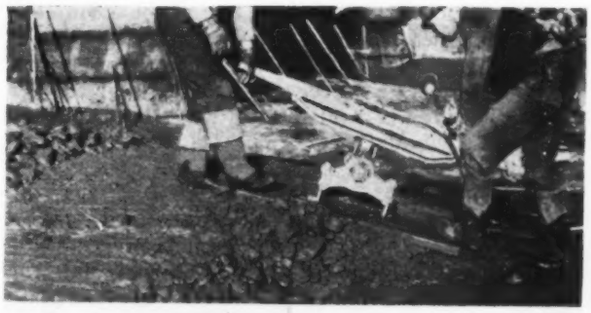
Vibrated Concrete for Dams, Tanks, Retaining Walls, Bridges and Sewers

VIBRATION is a new technic in placing concrete which can be used to advantage on many public works projects. It is a modern answer tc the demands for a better and cheaper way of securing an improved product.

The first uses of concrete in this country were for dams, retaining walls, foundations and other heavy sections. The methods of construction were vastly different from those of today. The concrete was mixed so dry that when squeezed in the hands very little moisture came to the surface. It was placed in thin, horizontal layers. Each layer was carefully rammed into place, using heavy iron tampers. Although built 30 to 40 years ago and exposed to very severe conditions, many of these structures remain today in almost perfect condition.

With the introduction of thinner sections of reinforced concrete and to meet the demand for economy, practice changed to the use of fluid mixtures which would require little, if any, labor to consolidate the concrete once it was in the forms. Since few specifications placed any limitations on the amount of mixing water, the practice was carried to the extreme. Many structures built during that era show the results—leakage where they should have been watertight, and seams of porous concrete subject to early attack by the elements.

Every construction engineer has been brought to realize the important effect of the amount of mixing water and the unsatisfactory results of using concrete mixtures that permit the ingredients to segregate during the process of handling and placing. Present conditions, however, do not make it practicable to go back to the practice of 30 or 40 years ago, but vibration equipment serves as a satisfactory substitute for it. This equipment vibrates the concrete at high frequency,



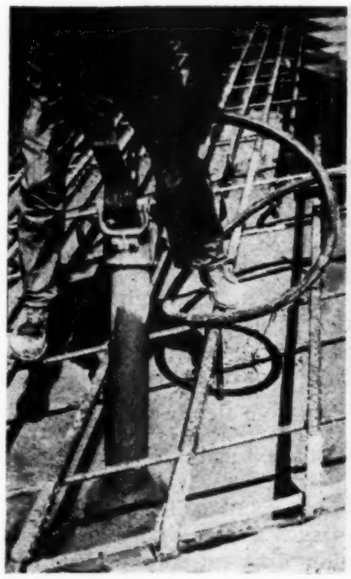
Top—Platform type vibrator in use on Pine Canyon dam. Bottom—Vibratory paving screed

causing a rather stiff mixture to become quite plastic and consolidating the mass in the forms. The equipment operates at 3000 or more frequencies per minute and the effect of a few moments' vibration at these frequencies is remarkable. The greatest advantage is the production of better concrete without adding to the cost.

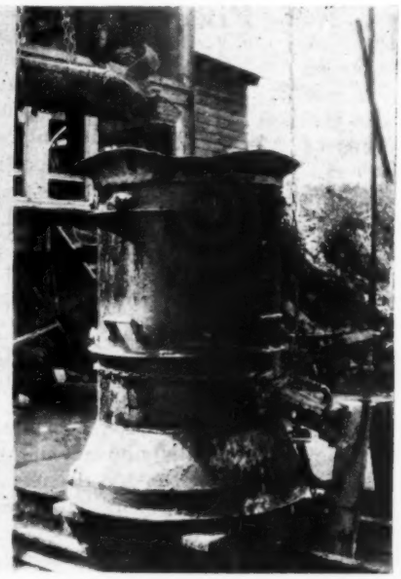
Better Concrete and Lower Cost

If for no other reason than that structures can be built having long life with greatly reduced maintenance, the equipment would soon pay for itself. A single repair job which could have been avoided might be sufficient to cover the cost of the equipment. Actual savings in material and labor to more than cover the cost of equipment are possible also. A saving reported on many jobs has been due to the fact that no patching was necessary to produce smooth surfaces free from stone pockets or honeycomb.

It should be pointed out that the improvements in quality are not due directly to the vibration. The improvements are brought about by the ability to place stiffer mixes. This allows the use of less water, which increases strength, watertightness and durability. Segregation is avoided. Watertight joints are secured. A given quality of concrete can be produced with a leaner mix, since more aggregate can be used with a given amount of cement paste. As an illustration, concrete with ½-inch slump is being placed



Placing 1½" slump concrete in heavily reinforced slab



Vibrator used in casting concrete pipe

with vibration in thin reinforced walls in Rochester's new sewage treatment tanks.

Dams and Retaining Walls

In the construction of dams and heavy retaining walls, the vibrators used have been of two general types —those which are inserted in the concrete and moved about in the mass, and those consisting of a vibrator mounted on a heavy plank or platform. The latter type is held on top of the batch of newly placed concrete and flattens it out over the previously compacted concrete. The internal type is available in various designs. One consists of a vibratory motor encased in a watertight shell to which a handle is attached, short or long, depending on the job. Another has a vibrating shaft in a tube. The driving unit may be rigidly attached to the tube or may be a separate motor or gasoline engine with a flexible driving shaft. Both internal and platform types have been widely used in combination. The platform vibrator makes it possible to handle and place large batches of concrete in a short time. The internal vibrator is necessary near forms to secure smooth surfaces. When manipulated in the mass of concrete it produces better bond between the successive lifts of concrete.

In dams and retaining walls, vibration not only permits more aggregate to be used but also allows a greater proportion of large sizes, utilizing material that is often wasted or which must be crushed when hand methods are used. Due to the coarser material, lower water content and leaner mixes, the shrinkage may be materially reduced, thus reducing the tendency of cracking. When the proper procedure is followed, there should be no chance of leakage at construction joints.

In Tank Construction

City engineers and others are often confronted with the difficulties of constructing concrete tanks and making them watertight. Tank walls are not very thick and this, combined with the presence of reinforcing bars, makes placing difficult. With hand methods a very plastic mixture is usually necessary. Because a low water content is required to produce concrete of the desired grade, this in turn requires a rather rich mixture. Even with such a mixture, it is extremely difficult to avoid segregation of the materials. Vibrators of the internal type discussed above can be used to great advantage in tank construction. They are available in sizes which can be manipulated between the reinforcing bars and can be operated in forms as deep as 20 ft. Vibrators can also be had which are attached directly to the battens or walers of the forms. These are electric motors or reciprocating units operated by compressed air. They are attached at vertical intervals of 3 to 4 feet, being raised as the forms are filled.

In tanks, construction joints are usually the greatest source of difficulty. With the overly wet mixtures so often used an abundance of water and fine material comes to the surface, forming a layer of laitance. This is weak and porous. When fresh concrete is deposited, the coarser materials tend to gather at the bottom of the next layer. Thus a poor joint is formed which will leak and be subject to attack from the elements. Vibration prevents laitance if the proper mix is used, because the consistency will be such that the materials will remain evenly distributed. Vibration also remixes the concrete after it is deposited, thus eliminating stone pockets. Watertight joints, therefore, should result with vibration.

Bridges, Culverts and Sewers

In constructing small bridges, culverts, sewers and similar structures, both internal and form vibrators can be used. In all such work there are many places where it is extremely difficult, if not impossible, to puddle the concrete into place by hand. Very wet mixes have been necessary for such locations. Wing walls and other parts of such structures have often shown the evidences of using overly-wet mixes, being readily attacked by water, freezing and thawing. Vibration of the forms or internal vibration makes it quite easy to place concrete of proper consistency even in these difficult locations and thus secure structures free of these weak places. Future maintenance is also greatly reduced.

Vibration can also be applied to pavements. Finishing machines have been equipped with somewhat heavier and wider screeds with 2 or 3 vibrating units attached to each screed. This arrangement permits the use of more coarse material and less water, producing a stronger pavement having less shrinkage. Hand screeds equipped with vibrators have also been used, especially on bridge decks. They might also be used on driveways, alley pavements and sidewalks.

Cost of Equipment

The cost of vibrating equipment varies, of course, with the type, size and source of power. About two to four hundred dollars is the range of single-unit vibrators. Extra-heavy vibrators may cost somewhat more. Equipment which takes several units, such as pavement finishing machines, costs proportionately more.

Vibration is specified on many public works projects. The Illinois Highway Department, for example, is this year requiring vibration on bridge and culvert construction. Bids on this work do not show increases in cost, as it does not take long for contractors to absorb the cost of the equipment. City engineers and others who do work by day labor can profitably look into the advantage of this improved method of placing concrete.

The Editor of PUBLIC WORKS will be glad to forward further information on request, or to supply a list of manufacturers of vibrating equipment.

Photographing Traffic Behavior

Accurate data on traffic behavior is being obtained by the Ohio State Highway Department by photography, with the cooperation of Dr. Bruce D. Greenshields, professor of engineering science at Denison University, the outstanding proponent of the method. Photographs of moving traffic are taken with a movie Simplex camera, capable of individual exposures called stop motion. A clock may be included in each photograph so that a traffic flow curve can be plotted. The pictures will show the speed, acceleration and (if taken from slightly above the roadway) the path of movement of all cars within the area studied. The type of car and the time are made a part of the record, which is permanent and can be restudied at any time.

By this method, if a certain section of a highway shows an unusual number of accidents the amount of congestion and the average speed on that section can be determined in the attempt at a solution. The amount of time lost by traffic delays, such as stop-lights, and the varying speed of vehicles on different lanes of a multiple-lane highway are among the other questions which can be resolved by this photographic method.

Studies in Water Consumption

Figures from Pacific Municipalities for 1933-34

THIS is the second installment of data on water consumption by months, covering some 500 cities throughout the United States. The first installment, covering 46 New England cities, appeared in the September issue. Subsequent installments will be published covering other portions of the United States.

In the table herewith, the first column gives the city and the state in which it is located; the second column gives the population as reported by the superintendent or engineer, or by the 1930 census reports. Often the population given by the superintendent or engineer is that served by the water department, and may vary materially from the census population.

The third column gives the percentage of services metered. In some cities, Riverside, Calif., for instance, which reports 100% meterage, and 265 gallons consumption per person per day, the irrigation supplies are not metered, which may some times account for a variation from the usual averages in monthly consumption per capita per person per day, generally as reported by the superintendent or engineer. Column four gives the average per capita consumption per day.

The remaining 12 columns, headed by the months, show the percentage of the total consumption in the months indicated in the table. It will be noted particularly that the winter consumption is much less than that shown in the New England figures presented last month, and that the summer consumption is considerably larger—*in percentage* of annual consumption. Thus, in New England, the January consumption was 7.80% of the total annual consumption, whereas in the 27 Pacific cities shown in the accompanying table, the January consumption is only 5.71% of the total annual consumption.

The July consumption for the New England group amounted to 9.49% of the total consumption; for the Pacific group, the July consumption is 11.68% of the annual total. The gross average of the New England cities for daily consumption was 72.7 gallons per day per person; for the Pacific cities it is 158 gallons per person per day.

In this connection, reference may be made to a somewhat similar study covering hourly, daily and monthly consumption figures, which was prepared by the Editor of PUBLIC WORKS and published in the October, 1932, issue (page 15), which showed the per capita consumption of the Pacific cities to average from two to four times as much as that of New England cities.

Monthly Water Consumption in Percentage of Total Annual Consumption for the Pacific States

	Population	*Percent Metered*	*Consumption*	*January*	*February*	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*October*	*November*	*December*
California:															
Alhambra	31,000	100	97	4.26	6.04	7.86	8.21	10.15	12.19	11.24	11.95	8.55	7.70	7.23	4.88
Burbank	16,500	100	..	4.96	4.47	6.76	7.92	7.11	10.18	11.74	12.52	11.25	8.78	7.72	6.05
Fresno	75,000	14	280	3.04	3.27	5.26	8.40	9.98	13.23	15.95	14.42	10.13	8.28	4.55	3.49
Santa Barbara	35,000	99	108	4.40	3.72	6.46	13.10	11.69	8.57	11.40	10.95	9.30	8.20	6.92	5.26
National City	10,000	100	..	3.96	3.66	5.57	8.35	4.77	10.96	11.32	12.92	12.01	11.07	9.60	5.40
Palo Alto	15,605	100	125	4.50	4.11	5.25	7.44	8.02	11.94	12.60	12.63	12.09	9.60	6.50	5.25
Riverside	32,000	100	265	4.41	4.07	8.11	7.61	8.97	12.57	12.77	11.18	9.50	9.28	7.31	4.21
San Diego	165,000	100	98	6.18	5.89	8.07	7.82	7.77	9.57	10.55	10.91	9.37	8.80	8.41	6.60
Santa Cruz	14,395	85	100	3.66	4.21	5.85	6.63	8.04	9.28	11.86	12.36	12.38	10.06	8.06	7.86
Anaheim	11,000	100	111	5.45	5.58	5.15	7.68	8.30	9.21	10.44	11.32	11.08	9.20	8.51	7.70
Burlingame	14,000	100	90	3.87	4.18	4.83	6.08	7.36	11.00	13.47	13.72	12.51	9.86	7.22	6.15
Lodi	7,000	5	358	3.06	2.74	4.24	7.91	8.56	14.81	14.80	15.42	11.30	8.77	4.86	3.45
Modesto	16,000	9	300	3.88	3.54	6.35	9.58	8.64	11.31	15.02	13.30	10.14	8.51	5.46	4.14
Oxnard	6,250	6	177	6.79	5.98	8.35	10.57	10.65	9.25	10.55	9.90	8.20	7.30	7.32	5.87
Pasadena	92,000	100	121	4.95	4.00	6.15	7.82	7.96	10.16	11.93	12.20	12.02	7.88	8.98	6.19
Pittsburg	10,000	100	50	7.25	6.45	7.24	8.05	8.55	9.65	10.30	10.42	7.20	8.82	8.20	7.75
San Fernando	7,567	100	118	4.98	4.38	5.35	7.75	6.10	10.43	10.72	14.70	9.60	10.74	8.65	6.50
San Jose	100,000	100	69	5.56	5.68	6.36	8.20	8.92	10.84	11.72	11.92	10.32	9.04	6.36	5.84
San Bernardino	38,000	100	150	6.37	6.73	8.30	7.77	7.87	9.61	10.23	10.24	9.60	9.60	7.87	6.09
Oregon:															
Medford	11,007	16	382	6.48	4.92	5.32	6.56	7.48	11.60	12.90	15.02	8.72	8.45	6.01	6.44
Klamath Falls	22,455	100	89	7.76	7.06	7.19	7.27	7.72	9.85	11.69	11.66	8.60	7.68	6.80	6.66
Eugene	18,900	100	144	7.88	7.03	7.44	7.22	7.07	8.55	12.63	12.16	7.82	7.62	7.11	7.75
Marshfield	10,000	95	81	7.81	7.04	6.82	6.87	7.58	7.93	10.19	9.74	8.96	9.15	9.25	8.57
Washington:															
Tacoma	110,000	30	256	8.90	6.88	7.25	6.81	7.70	8.92	10.82	10.90	8.70	7.90	7.70	7.32
Hoquiam	12,766	95	111	8.11	6.34	7.74	9.46	9.65	7.75	8.13	8.76	8.61	8.22	8.02	9.07
Seattle	365.583	100	107	7.95	7.23	7.17	7.12	7.58	9.20	11.02	10.81	9 46	7.98	7.25	7.16
Yakima	22,101	100	..	7.67	7.41	6.67	7.50	7.70	8.36	8.97	9.87	9.44	9.53	8.86	7.94

"Roughograph" Locates Pavement Bumps

A USUAL method of locating bumps on pavements is by means of a five-foot straightedge, the operator stooping over and laboriously straightening and marking the entire area of the pavement. His labors were considerably lessened when the resident engineer allowed a rigid handle to be attached to the straightedge and the assistant assigned to that disagreeable task might walk upon his hind legs instead of creeping about on all fours.

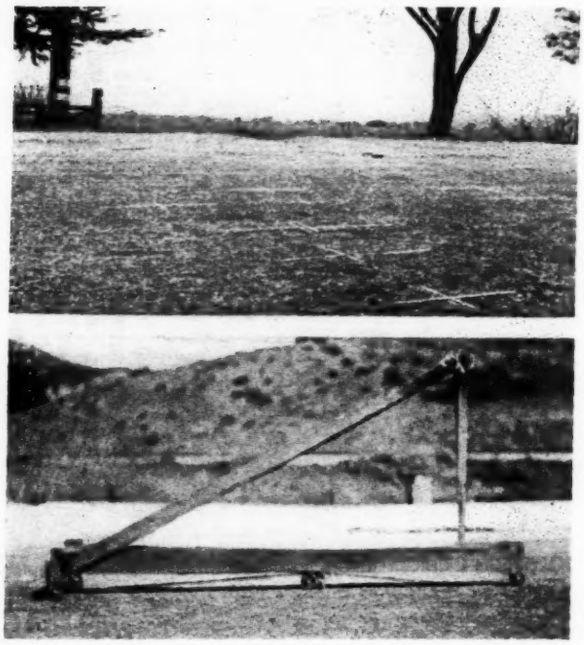
But the engineering assistant who is up and coming is not satisfied with one small improvement. Numerous devices have been tried out which would indicate the presence of a bump by watching an indicator or a recording stylus as the device was slid or wheeled along the pavement surface.

Credit is due to Harry D. Johnson, assistant resident engineer on 5.1 miles of asphalt pavement between Santa Clara river and Castaic school, California, for working out the principle of the "Roughograph," which not only finds the bumps but automatically marks their location on the pavement. Mr. Johnson was ably assisted by his co-worker, V. A. Miller, in working out the mechanical details of this device, and one rainy afternoon, when a lull occurred in paving operations, a crude affair was constructed, using miscellaneous lumber and hardware.

The original machine consisted of a frame five feet long with a runner at each end and a third runner, set at the mid point of the frame, connected by means of a compound lever to a crayon marker set immediately behind the third runner. The compound lever was so arranged that a slight upward movement of the third runner caused the crayon marker to move downward, the movement of the crayon being several times greater than that of the runner; a ratio of 4: 1 between the crayon and the runner was found to be satisfactory. The runners showed considerable wear after several hours use and small wheels were substituted, a second wheel being placed at the forward end to allow the machine to stand alone.

The "Roughograph" is wheeled longitudinally along the pavement surface and as it passes over a bump the middle wheel is raised in respect to the supporting wheels at either end of the frame. The marker crayon is moved downward so as to bear against the pavement surface and leave a mark.

Since the wheel and crayon are set adjacent to one another the mid point of the mark is also the mid point of the bump. By wheeling the "Roughograph" over the pavement on paths two or three feet apart all of the bumps are marked, with the marks running longitudinally along the pavement, and if desirable, cross marks can then be made on each bump. The accompanying photograph shows a section of pavement after being so marked.



The first "Roughograph," built by the inventor. Above—High spots marked by the Roughograph.

The original machine being of rather crude construction, it was decided to have one built more substantially, and accordingly plans of the "Roughograph" were turned over to W. B. Cannon, superintendent of equipment at Shop 7. The crayon marker required constant adjustment to compensate for wear, and to eliminate this feature, details of a device to use a fluid, instead of a crayon for marking were worked out and a machine built that would leave one, two or three marks, according to the height of each bump.

Phenols Removed from Sewage by Compressed Air

Under suitable conditions, phenols dissolved in sewage may be changed by aeration in insoluble phenols and removed by filtration, according to Prof. Dr. A. Schulze-Foster and Dr. L. W. Haase. Air distributed in as small bubbles and as uniformly as possible should be applied in sufficient quantity to bring the sewage to a strong boil. If a high percentage of removal is desired, a secondary treatment in a shallow tank (1.5 ft. deep) is necessary. The duration of aeration is important; with sewage containing 1% to 2.3% phenol, 60% was removed in one hour and 70% in two hours; if the phenol exceeds 2.5% the aeration period is too long to be practical or economical. Also the temperature must be 158° F or higher, being treated by steam during aeration if necessary; the higher the temperature, the more rapid the polymerization of the phenols. Also the pH should be between 8 and 10. The presence of insoluble material, such as lime, assists in the formation of insoluble compounds.

Considering the large amount of compressed air and heat required, the process does not seem to be practicable for other than laboratory practice, especially as only a part of the phenols are removed.

The Editor's Page

Municipal Generating Plants Increasing

The current trend in municipal electrical utilities is toward the development of isolated municipal generating and distributing plants, according to an article in the May issue of the *Journal of Land and Public Utility Economics*. Studies made by Paul Jerome Raver indicate a reversal of the 1923-28 trend when there was a distinct tendency toward the construction of municipal distributing systems which would purchase power from already existing private or public sources of supply. Of 141 new and proposed municipal establishments for 1933 and 1934, 116 or 82 per cent are of the isolated type which generate their own power. The Journal points out that, regardless of the merits of one type of plant over the other, there is a certain inconsistency between the trend of municipal ownership toward isolated plants and the programs of state and national large-scale hydro-electric developments.

The abundant construction of both classes, however, will provide an opportunity (which it is hoped will be utilized) to assemble reliable data on which to base future decisions as to the conditions under which each class would be preferable, both economically and from the point of view of general policy. In this issue will be found articles dealing with a successful isolated plant and with the TVA power distribution project; and we expect to publish similar articles in our future issues giving official information in this field.

The Low Cost of Municipal Service

The taxpayer gets more per dollar from the municipal services his taxes pay for than from any other money he spends. At least, those living in Akron, Ohio, do, according to figures given by the Director of the Department of Public Service of that city. He has figured the average cost per family of each municipal service and of those furnished by private corporations in that city. These show that the cost of a 2-party telephone line ($42 a year) is almost exactly the combined cost of police ($7.80) and fire ($5.62) protection, street lighting ($2.73) and cleaning ($1.20), garbage collection ($1.52), water, including bond interest and sinking fund ($12.00), public health service ($1.68); sewer maintenance and sewage disposal, including bond interest and sinking fund ($11.34), municipal court ($1.34), parks ($0.09), and general expenses ($4.63), less $4.00 revenue derived from police, health, sewer and general services. In addition, a low average cost for electricity is $15 per family, or more than that of water, garbage collection and street cleaning combined, and the electric bill is double this if there is an electric refrigerator; and a low average for gas is $18; a total of $90 for these three private services.

Another illustration is furnished by Hinton, W. Va. (see page 11), where the total budget appropriation this year is $27 per family (counting 4½ persons to a family), which is 54 cents less than in 1920 in spite of rising prices and wages. In spite, too, of increased services rendered—three times as much refuse per capita collected, 20 per cent more street mileage maintained and cleaned and 25 per cent more street lights giving several times as much light. All that for about 50 cents a week for a family—probably less than father pays for his cigars.

The Hinton report deserves mention for other reasons—its compelling readableness and low cost. No citizen who takes any interest in either his city or his taxes can refrain from reading such reports as City Manager Nowlan issues about once a month, if the report is placed before him. And in reading it he will receive, painlessly injected, information that should benefit both him and his city. As to cost, this must be merely nominal, for the illustrations are drawn, we assume, by some bright assistant in the city manager's office (or possibly by Mr. Nowlan himself) and the report is run off on a duplicating machine in the office. But its value in imparting information and arousing interest of the citizens in their government is many times that of the standard report, printed, with abundant engravings and charts and scores of tables of never-read data, at a cost of hundreds —sometimes thousands—of dollars.

The moral of all of which is that, if a city engineer or city manager is accused by the taxpayers of wasting their money, it is probably because he has failed to educate them in facts like the above; and if he has a real will to impart the information he will find a way.

Public Utilities, Taxes and Bond Limits

A great many cities are up against it financially. Tax rates have been increased to the legal limit, or that of the patience of the tax payers. Bonds also have been issued up to the legal limit, one result of which is the impossibility of getting loans from the Federal emergency funds, unless for projects which can be financed from the revenues they will produce, and such municipal projects seemed at first to be limited to water works and toll bridges.

But some cities already have been financing sewerage systems by charging a rental for services, and with the incentive referred to, many more have arranged to do so. According to our latest information, twenty-six States have special laws under which their municipalities can finance sewerage systems in this way. Here is an opportunity for many cities to lower their tax rates, or to devote the present taxes to other desirable purposes. Also an opportunity for those which have reached their bond limits to build sewerage or sewage treatment plants.

But it is not necessary to stop at sewers. Some cities remove snow from sidewalks and assess the cost against abutting property. Garbage and ash removal could be assessed in the same way; also street lighting, assessing by districts; and possibly other services which can be identified with individual properties or groups of properties. We believe most citizens would rather pay directly for services rendered than the same amount as an increase in taxes. If both can be avoided, that is best; but, if not, this idea is worth considering.

THE WEATHER

Snow and Colder followed by rain and ice.

SNOW TIMES

Handling the Snow Problem In Saranac Lake

By W. E. Timmerman
Village Manager

I started using snow removal equipment in 1922 and have used several different types and have found that any one type is not suitable for all kinds of snow that is required to be removed. Of course the secret of removing snow is to start at the proper time and keep moving. The first storm is always the hardest, as one does not know just how much snow will fall, and I never start the plows out until at least six inches of snow has fal'en, setting the blades of the plows up about two inches, as care is necessary in not hitting manhole covers, etc., that might extend up above the pavement, also the plows travel at a slow rate of speed.

After there is snow packed on the pavements the plows are always let way down, as it is very important not to let the snow build up, as this is what causes ruts and a little extra work plowing saves money in the spring removing ruts.

One trouble that I have noticed in some p'aces, especially out in the country, is that plows will go through once and if the storm stops they do not bother to go back and clean up and widen out the road to make room for the next storm. Snow should be pushed right back to the ditches.

My plows generally begin work at about eleven P. M., as there is no traffic to interfere and much better results can be accomplished. After the first storm the plows begin when four inches of snow have fallen.

We have approximately 28 miles of streets to be plowed in Saranac Lake, one-half being hard surfaced roads and the balance being dirt and gravel. The village is divided into zones for the operators on the plows to follow, and each plow has its zone to take care of. Our sidewalk plows start out at 4 A. M. in order to have walks all opened before school time.

Our equipment consists of one 3½-ton Larrabee truck with 47S Frink plow with two wings which will plow about 18 feet in width, this arrangement being used to plow through and open up center and then plow and one wing is used to widen back. One 1½-ton International truck with small Frink plow is used to open up, outlaying streets, before the larger plow gets there. We have a Rome power grader with 10-foot blade which does wonderful work in the business sections and also to clean up street intersections after the storm. Also an International tractor with Baker blade plow that is used in light snowfalls.

The operators are regular village employees on straight time basis and receive $25.00 a week. If the storm lasts over eight hours the crews are changed. One of the most important factors in snow removal is capable men on the plows; and men should not be changed frequently, as a man should know his equipment and he can then accomplish better work. Two men are assigned to each plow. I believe that trucks equipped with plows are much more satisfactory in village streets, as they can cover the territory in much faster time, although if there are drifts of any height, power and not speed is the main factor. As mentioned, it is a good plan to have at least two pieces of equipment—tractor and truck—and you are prepared for all conditions.

A sidewalk plow at Winnetka, Ill. Such plows are also used in Saranac Lake. Plowed sidewalks allow children to reach school promptly and are a great convenience to citizens.

It is not necessary to use any snow fence within the village of Saranac Lake, although it is used to a great advantage outside of the corporation, the majority being about four feet in height and placed about 60 feet back from the highway.

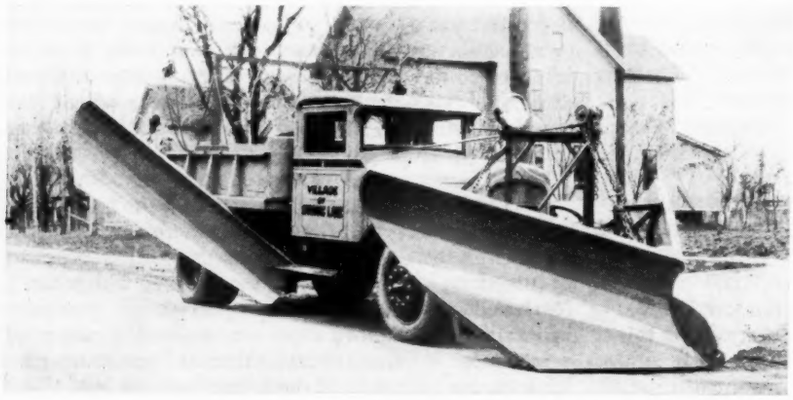
If the snow on the street becomes soft or loose, or in case of a thaw, we immediately remove it. While this may seem like unnecessary expense, it is much cheaper than removing ruts in the spring. We have very little trouble with ruts in Saranac Lake, due to this practice.

Of course we have hilly streets and one of our worries is slippery streets. I have used calcium chloride on the hills and this has solved the greater part of the problem. For ice on the sidewalk we mix about 100 lbs. to 1½ yards of sand. I have used calcium chloride for six winters.

I have no record of the exact snowfall last winter, but would say that between five and six feet fell from early November until April.

No matter what equipment you have, from my experience I must stress the importance of getting started before the snow gets too deep and to keep moving.

Streets that are kept clean during the



One of the Saranac Lake units.

winter are an important factor to the public. I can remember back during 1922-23 when side streets were just beginning to be plowed that the taxpayer thought it was a waste of money, and I used fire protection as one of the main reasons why they should be plowed; also doctors' service in case of sickness. Now the people on the side streets want their streets plowed first.

Public officials are giving the taxpayers good service when they provide well kept streets during the winter.

The total cost of our snow removal during the winter of 1933-34 amounted to approxixmately $4000, which includes removal of the snow from business sections with trucks after each storm, sidewalk plowing and use of sand and calcium chloride.

Firemen Blocked by Snowdrifts; House Is Destroyed

Fire destroyed the 20-room home of William E. Carter, Upland, near Unionville, Pa., the night of last Feb. 27. The local newspaper in describing the fire said: "Firemen, summoned from Kennett Square and West Grove, were unable to reach the scene of the blaze because the roads were blocked by snow and ice. Neighbors were aroused by an alert telephone operator and formed a bucket brigade, but the flames spread to the entire structure, which was destroyed."

A Field Day 'Mid Snow Banks:

The Royal Automobile Club of Italy sponsored a field day for snow removal equipment recently. High up in the Italian Alps, where nature provides only 6-foot blankets of snow ordinarily, snow removal equipment was given a try-out; but not content with what nature provided, the officials in charge, added some drifts of their own, in modulated steps, 5 to 10 feet deep. On a 15% grade, the equipment had to clear snow with a depth of 8½ feet, leaving only 2 inches on the roadway. When a depth was reached which slowed them down to 7 feet in 5 minutes, they were through. This event was reported to us by the Caterpillar Tractor Co., and the illustration shows a "Cat" diesel 75, operating a Snow King Rotary. This outfit won the prize. Operating costs are reported as being only 70 cents per hour of operation.

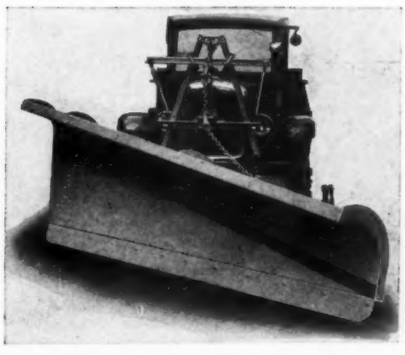
Above: Coming through the drifts at Cortina D'Amprezzo, Italy. Below: A snow removal unit of the Arizona Highway Dept.

Two winter views on Highway 66, Arizona. Photos by Norman G. Wallace, Arizona Highway Department.

"Good Roads" Snow Plows

Reversible Blade Plow

Strength and rigidity at minimum weight are embodied in moldboard, push-frame and the trussed semicircle. The wide arc of the semicircle, distributes the "thrust" evenly over entire length of moldboard, through *four* hinged push connections and permits free oscillation of the plow to conform to surface contour. A moldboard of great strength has been developed, due in great part to the improved method of stiffening, both vertically and horizontally. Castors, with tapered roller bearings and adjustable stems, support the plow and reduce the frictional load on the truck, leaving the maximum of motive power for the actual work of snow removal. Model 10-E is equipped with dual automatic safety



Good Roads Model 33A Snow Plow.

Good Roads Model 10E Snow Plow.

The Joy Snow Loader at work

blade trip mechanism, safeguarding plow, truck and operators. Hydraulic lifting device, adjustable underframe for attaching plow to truck and castor stems are arranged with variable adjustment so that the blade may be set at any desired clearance, within reasonable limits. No hand tools are required to make the various adjustments possible on all "Good Roads" Plows.

The "Good Roads" line of reversible blade type plows, embraces six models of varying sizes, suitable for use with any standard motor truck of 1½ tons up to the heaviest built.

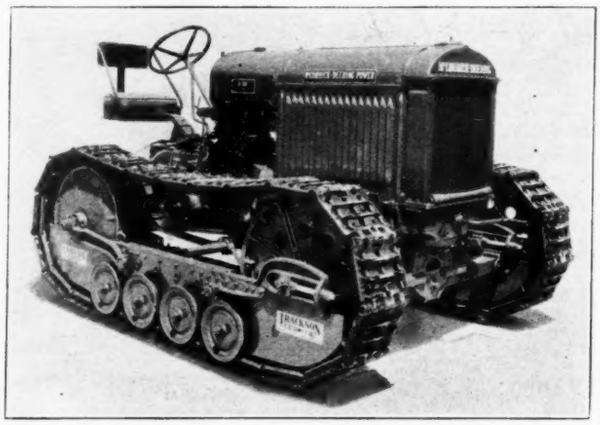
Non-Reversible Blade Type, High-Speed Plow

For safety in plowing at high speeds "Good Roads" presents Non-Reversible Type blade plows. The curved top of the tapered moldboard projects well forward and forms an effective snow shield, eliminating the annoyance caused by snow flying back against the windshield and obstructing the operator's vision, clogging the truck radiator and other mechanism. The curvature of the moldboard is so formed that the snow discharged by the plow is thrown well out to one side, away from the highway, and the edge of snow bank sloped off to prevent it falling back into the cleared surface behind the plow. Aside from the varying construction of the moldboard, Model 32-A is in other respects similar to Model 10-E. The semicircle feature is retained and permits changing the plowing angle and tilting the blade to meet different snow conditions. Four models cover a range of sizes for use with trucks of 1½ tons to 7 tons capacity.

"Good Roads" are also builders of V-Type plows, for use in connection with motor truck equipment of from 2 to 7 tons capacity. Catalog No. 53, just issued by the Good Roads Machinery Corporation, Kennett Square, Pa., illustrates and describes the twenty different models of snow plows, built by this company, for use in connection with trucks.

Joy Snow Loader:

For removing snow from city streets, the snow loader has many long-demonstrated advantages. During the exceptionally heavy snow falls which New York City suffered in the winter of 1933-34, three of the Type PL-2 Joy snow loaders were employed in loading the snow from the sides of the streets, where it had been pushed by plows and by hand workers, into trucks for final disposal. The chilly-looking picture at the left shows a Joy loader at work, discharging into a Mack truck.



Trackson Tractor with McCormick-Deering Power

Time-Saver Snow Fence Posts:

"Timewasters" will be found on page 7, and the time saved by using these posts can well be spent on them. Time-Saver posts are a product of the Northfield Iron Co., Northfield, Minn. They are guaranteed for 30 pullings and drivings "if not driven into stone, hardpan or frozen ground." Anchors are not needed, nor are clamps or tie wires, as the fence cables engage pressed steel hooks at the top and near the bottom. This feature also enables the fence to be raised readily when the snow becomes deep.

"American" Snow Plows:

A full line of snow plows for operation by trucks, sizes 1½-ton and upward, is being manufactured by the American Hoist & Derrick Co., St. Paul, Minn. A considerable number of dealers handle these plows. A list of such dealers, and complete data on the plows will be sent on request to the manufacturer.

Marmon-Herrington Trucks:

Four-wheel drive trucks are especially valuable in hard snow removal work, since they provide sure traction, speed and power. The Marmon-Herrington have a low center of gravity, while maintaining a high road clearance. They are adaptable to every type of snow removal equipment, and this equipment may be attached, detached and adjusted without trouble or loss of time.

The Caterpillar Diesel Fifty is fully described in one of the characteristically beautiful publications of the Caterpillar Tractor Co., Peoria, Ill. 48 pages, Ill.

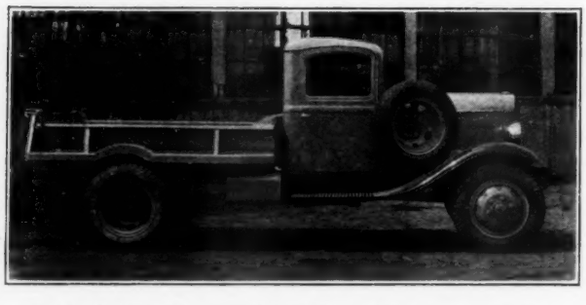
The full line of "Caterpillar" Leaning Wheel Graders is pictured and described in a new illustrated 32-page catalog. Write for a copy either to your "Caterpillar" dealer or direct to Caterpillar Tractor Co. at Peoria, Illinois.

The new Austin No. 8 Maintainer, a rugged and highly simplified piece of equipment, is described in a bulletin just issued by the Austin-Western Road Machinery Co., Aurora, Ill.

New catalog insert for loose leaf booklet, W-5, from American Chain Co., Bridgeport, Conn., on tire chains, chain repair tools, towing chains, etc.

Prof. R. A. Moyer reported on "Skidding Characteristics of Road Surfaces" in a paper before the 13th annual meeting of the Highway Research Board, last December. His report has been reprinted by the Asphalt Institute, New York, N. Y., and can be obtained from them on request.

Wagner CoMax, a brake lining for which exceptional characteristics are claimed, and which should be well fitted for the severe conditions under which construction and maintenance trucks are operated, is described in a folder issued by the Automotive Division, Wagner Electric Corp., St. Louis, Mo.



4-wheel drive Marmon-Herrington, 1½-2 tons capacity. Model A-10-4

Northfield Snow Fences keep drifts away from highways.

INTERNATIONAL HARVESTER

POWER and STAMINA
to Fight the Snow Blockade

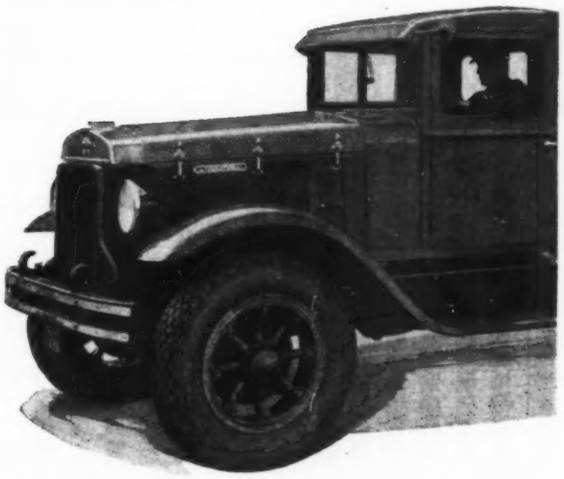
At Left: An International Model A-7 Truck cutting through the snow in upper New York state last winter.

Below: This shows the Model A-7 when its front end is out of the snow. International Trucks sizes range from ½-ton to 10-ton and meet every hauling need.

● Every year more INTERNATIONAL TRUCKS and McCORMICK-DEERING TRACTORS are brought into the fight to keep the roads of the snow belt open—because they've got the power and stamina to buck the drifts twenty-four hours a day.

These big, powerful, heavy-duty trucks and crawler-type tractors are solidly built throughout. They can take the terrific punishment of this hard work. And after they have finished their winter's work, they can be used the rest of the year on other road jobs.

For complete information on International Trucks and McCormick-Deering Tractors, see our nearest branch or dealer.



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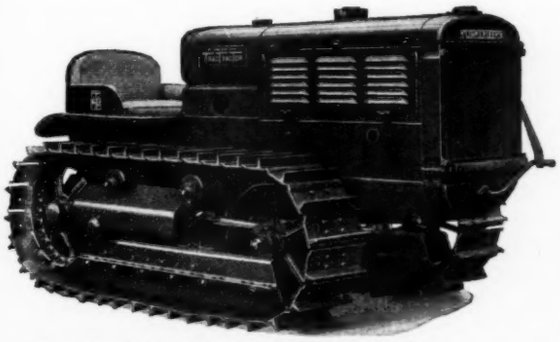


Above: The McCormick-Deering T-40 TracTracTor.
At Right: The T-40 opening a road through the mountains. The McCormick-Deering Industrial Tractor line includes the T-40 TracTracTor (gasoline or Diesel engines); the T-20 TracTracTor; four sizes of wheel tractors; and three power units, including one with Diesel engine.

When you need catalogs—consult the *classified* READERS' SERVICE DEPT., pages 63-65.

Preparedness for the War on Snow

THE secret of Rochester's success in snow handling is *Preparedness*. Snow work begins on September 1st, when the Maintenance Division of the Department of Public Works begins an examination of all the equipment used in snow handling to insurethat it is in good condition ready for instant service. All machines are turned over, any repairs needed are attended to, new pieces of equipment needed to replace those worn out or to increase the number to meet increased demands, are ordered.

The Estimate of the Situation

To find out what the next winter's demands will be, a detail plan is worked out. The city is divided into four main districts and into about 50 small sections, and specific pieces of equipment are assigned to each section. In a one-mile circle enclosing the down-town district, city owned equipment is used. In the other districts city-owned plows are pushed by hired trucks, and arrangements for these are made beforehand with truck owners and a specific plow assigned to each truck. Each district or section is in charge of a superintendent, who knows how to get in touch instantly with the driver of every ruck hired for his section.

Preparedness is not confined to tuning up the equipment—the men are tuned up also. The Deparment conducts a training school for operators of loaders and other equipment and for instructing all men in their duties, so that when any man is called up, night or day, and otld to get on the job, he knows just where to go, what equipment to take with him, what to do with it and how to do it; and, so far as it is possible to foresee all emergencies, just what to do when each arises. The middle of a snowstorm is no time for teaching an operator how to install a stalled loader or truck, or where to go when he gtes a street cleaned up, or even what to do if his helpers fail to show up. The famous slogan "The mail *must* go through" is typical of the spirit that is drilled into the snow cleaning force from top to bottom.

"On the Mark"

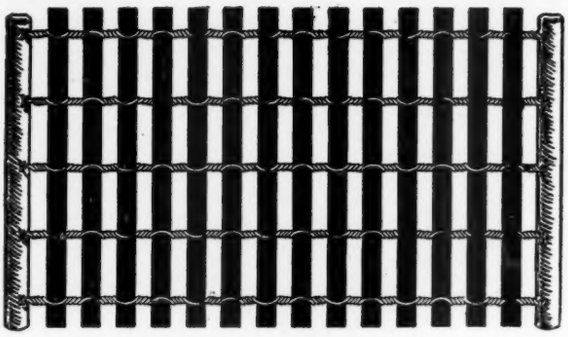
By November 15th all must be ready to go at the drop of the hat. The hat is dropped by Edwin A. Miller, Supervisor of Maintenance of the Department of Public Works. He contacts every day with the local weather bureau, learning the where, whence and probable weather of all the low-pressure centers so far as that bureaucan inform him. Given the right temperature, a low coming from the west probably means snow, but if one is headed up the Ohio Valley it is likely to mean a blizzard, and every superintendent is warned to be up on his toes for a quick start at full speed. At the airport is another bureau which issues hourly bulletins of the weather, and full use is made of this source of information also. Arrangement is made for notifying Supervisor Miller at his home should snowing begin during the night.

As soon as sufficient snow has fallen, horse-drawn wooden snow plows start cleaning the sidewalks. This work is done by contractors using their own plows, the cost being assessed against the abutting properties. The contract prices generally run well under 2 cents per lineal foot of sidewalk for the season. Each contract provides for keeping the sidewalks clean in a clearly defined district.

As the snow reaches greater depth, the truck plows begin on the roadways and continue as long as the storm lasts. The snow moved to the sides of the roadway is removed from the business center (approximately a one-mile circle), and from other streets should its depth and traffic needs require it. Effort is made to get all streets cleaned (including removal as well as plowing of the snow) before 7 a. m. With the snow plowed into windows, five snow loaders are used, each served by five or six trucks. These carry the snow to large dump holes in the floors of the bridges acress the river which bisects the business district, through which it is chuted into the river. It takes an average of one minute to load a truck and two for it to reach a dump hole—5 or 6 minutes for a cycle of load, go, dump and return, so that the 5 or 6 trucks keep the loader in continuous operation. To minimize the interference of these snow trucks with each other and with traffic, they follow a regular route, out one street and back another.

Meantime hand shovellers are cleaning cross-walks and doing such other desirable snow removal as the plows and snow loaders cannot perform so effectively. These men are served by smaller trucks, which remove the snow shovelled into them by hand and dump it into one of the storm or relief sewers through manholes.

DON'T LET SNOW BLOCKED ROADS
STOP YOUR GAS TAX REVENUE



FOR EFFECTIVE DRIFT CONTROL
USE MATTSON SNOW FENCE!

MEETS ALL STATE HIGHWAY SPECIFICATIONS—made from heavy pickets cut especially for our use, woven between the best grade of copper bearing steel wire, heavily zinc coated and heat treated after galvanizing to give maximum protection against corrosion. Shipment can be made from branches located conveniently in your territory.

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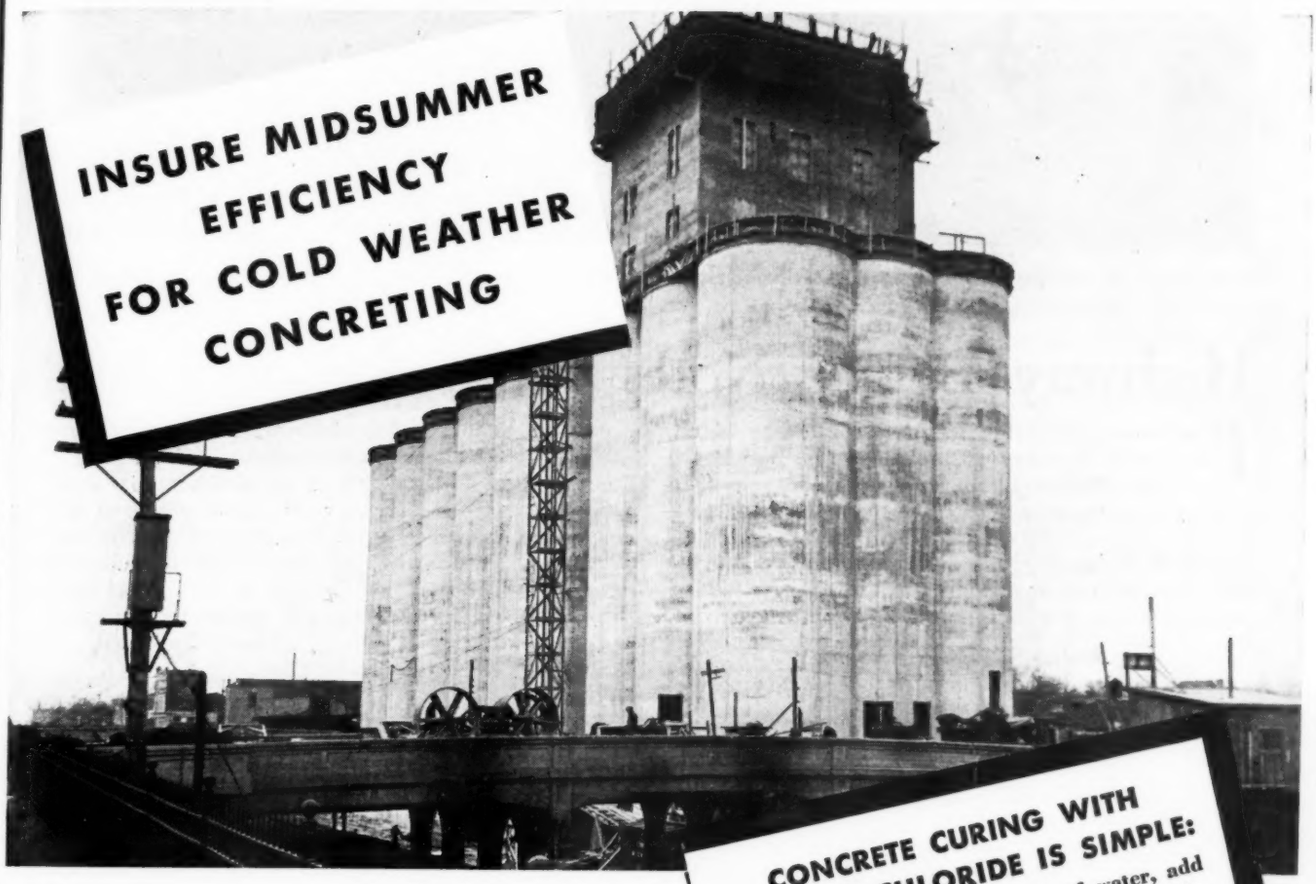
Main Office, Peoria, Ill.

When writing, we will appreciate your mentioning PUBLIC WORKS.

KEEP UP THE GOOD WORK



CONCRETE CURING WITH CALCIUM CHLORIDE IS SIMPLE:

(1) To a barrel one-third full of water, add one bag (100 lbs.) of flake Calcium Chloride. (2) Stir and then add enough water to half-fill the barrel (25 gals.), making sure that all the Calcium Chloride is in solution. (3) Add two quarts of this solution to each bag of cement in the mix — reducing mixing water accordingly.

WINTER construction is vital to unemployment relief. And now concreting need not be delayed and concrete quality need not be sacrificed through exposure, thanks to Calcium Chloride, the modern and widely accepted method of concrete curing.

Calcium Chloride used in-the-mix is worth many times its cost in giving summer strength to out-summer concrete. It more than doubles the early strength in the critical period. In cold weather it accelerates the hardening to afford positive protection against frost. And in freezing weather it greatly reduces the time and protective measures required to attain working strength. No other method offers the surety and economy made possible through Calcium Chloride curing.

For literature and complete information on Calcium Chloride concrete curing, write to any of the following members of the

CALCIUM CHLORIDE ASSOCIATION

MICHIGAN ALKALI COMPANY . . 60 E. 42nd Street, New York City
SOLVAY SALES CORPORATION . . 61 Broadway, New York City
THE DOW CHEMICAL COMPANY . . . . . Midland, Michigan
THE COLUMBIA ALKALI CORPORATION . . . Barberton, Ohio

CALCIUM CHLORIDE

• FOR MODERN CONCRETE CURING •

When you need catalogs—consult the *classified* READERS' SERVICE DEPT., pages 63-65.

Turbulent water for the diver (who's feet show at the top of the ladder). Ladder enters deeply submerged shield

Moving shield along back face of pier. Typical joints and beds in stone work above low water

Highway Bridge Notes From Rhode Island

IN reviewing the bridge problems of Rhode Island, George H. Henderson, Chief Engineer, State Board of Public Roads, in his report for 1933, says: "In making a conservative estimate of the probable cost, we find that over $2,000,000 will be required for early replacement of existing structures, or to complete necessary structures on other routes." Approximately half of this expenditure will be required for replacements.

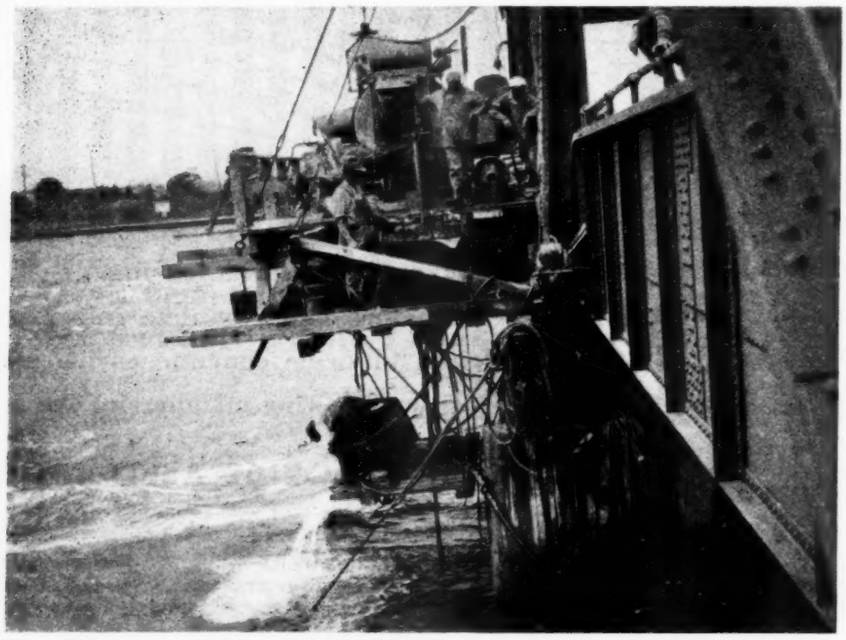
Bridges for Future Widening

Many bridges are on routes of a secondary nature, but this does not limit the load that may be imposed on the structures. Wherever practical, new bridges on secondary roads have been designed for loads equivalent to those of the primary system. The cost has been reduced to a minimum by limiting the width and selecting a type which would involve the smallest immediate outlay, while giving reasonable service life under the anticipated conditions. The smaller-span structures will be of concrete, and the width will be limited to 30 feet, but the foundation work will be laid out so as readily to adapt itself to widening operations whenever future highway developments require it. Experience indicates that a 40-foot bridge is the minimum that should be used for a road carrying a reasonable volume of modern traffic, and widening work is usually expensive when compared to the cost of a structure built to the full width at the outset. But by developing footings with an eye to the future, much of the expensive underwater work ordinarily necessary in widening has been eliminated.

Developments in Construction

The outstanding project of the 1933 program was the Stillwater viaduct, completed during the latter part of the summer. This bridge is the largest structure undertaken on the state highway system to date, and was built at a cost of less than $3 per square foot of superficial deck area.

Slight waves and irregularities in concrete surfaces are very noticeable in bridge structures, where bright sunlight and deep shadows emphasize imperfections which otherwise might pass unnoticed. Sheets of pressed wood fibre and of laminated wood specially treated for resistance to moisture from the concrete have a considerable advantage over boards in form facings, and also allow a reduction in the joints. The resulting continuity of the panels adds a degree of stiffness and resistance to distortion that is desirable. The economical use of these new materials, which are thinner than the materials formerly used, involves careful design and correct spacing of the supporting form work. Apparatus has been developed by the highway laboratory by means of which a hydraulic pressure equal to the anticipated concrete load may be applied to the actual specimen of the proposed form, and the resulting minute distortions measured by dial indicators. This apparatus at one and the same time tests the panel facing, the studs, the rangers and ties as planned, under field working conditions,



Suspended platform for concrete mixer, air compressor, pumps, grout, etc., swung off side of bridge to prevent obstruction of highway

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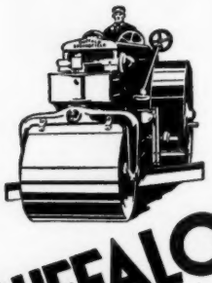

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avoiding any guesswork, and thus eliminating the chance for producing unsatisfactory concrete surface through bulging. This apparatus was used on the Stillwater viaduct, and on other recent bridges.

Restoring Bridge Foundations

The work of restoring the main foundations of R. I. Stone Bridge extended from the latter part of September, 1932, to the early part of October, 1933. During this period the services of a diver were employed nearly continuously except for about a month in June and July to permit the moving of equipment and the preparation of special equipment to complete the work. The current is very swift at this point and the diver worked the major part of the time within specially built steel and wooden shields which were moved about on the faces of the pier as the work progressed. The open joints in the stone work were in many places 3 or 4 inches in width, and at other points where the stone was displaced exceeded these dimensions. Some of the larger stones are 2x4x12 feet and wherever practical they were jacked back into position. In addition, the diver's work consisted of carefully scraping the stone surface free of marine growths and packing the joints with a special sand-cement mortar and granite spalls. Two-inch pipes were inserted in the joints at frequent intervals to make provision for subsequent pneumatic grouting operations. A large quantity of heavy stone rip-rap was removed and later replaced about the base of the piers, making the lowest joints accessible.

The special cement used was prepared by the Crandall Engineering Company of Cambridge, Mass. It has the peculiar property of being very tenacious and cohesive when mixed with sand. The prepared mortar was washed very little by the rapidly moving water, and the pointed seams are as tight as if the work could have been done under dry conditions. Such underwater work is a slow and tedious process, but in spite of the difficulties encountered, good progress was made. The method used was the only feasible way of restoring these bridge foundations, which were beginning to develop cracks through the stone work, without completely dismantling the structure.

As the work progressed it became evident that the piers were made up of a dry laid stone masonry shell backed up by dry laid rubble work and tied together by three vertical chimneys of concrete placed under water after the stone work was completed. Although the joints were poorly bedded and some of the stones displaced, the original work proved itself to be surprisingly stable. Level observations have shown no appreciable settlement in the piers since the structure has been under state control. However, the restoration work was most opportune, as new cracks were noted before the work was fully completed.

It was originally planned to fill void spaces in the northeasterly portion of the east pier with concrete, and for this purpose the state forces undertook to sink a well from the top of the pier. Core boring equipment cutting a shaft 30 inches in diameter, performed very satisfactorily through the upper or consolidated portion of the pier, but on reaching the rubble it was found necessary to abandon the operations, which threatened to affect the stability of the pier.

After the pointing of all joints and seams in the foundations, the interiors of the piers were filled with a Portland cement-sand grout injected through the 2-inch pipes into the voids of the interior stone work and into places not filled by the pointing material. The equipment was specially designed and built for the purpose

by the state maintenance forces. The results obtained by the grouting processes were very good. Samples taken from the various grout pipes showed a cement-sand matrix of very good consistency, practically free from laitance, even when sampled at the extreme opposite end of the pier and at a point which was at a much higher level than the pipes into which it had been injected. A total of 1,986 bags of cement, or about 115 cubic yards of grout, was required to fill the west pier, and 1,865 bags required for the east main pier.

The bridge foundations, now that they have been consolidated with the grout, have vastly improved the stability of the structure. Formerly even the passage of a vehicle of moderate weight over the deck could be felt in noticeable tremors on any part of the structure. This failing has now been practically eliminated.

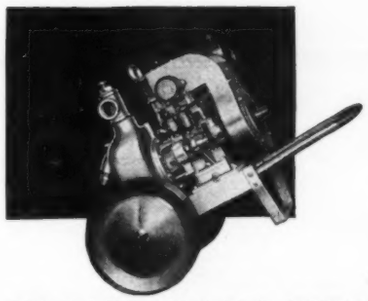
In order to avoid any delays in obtaining help to assist the diver in his work under water during the process of reconstruction of the foundations at R. I. Stone Bridge it was necessary to have an ample stand-by crew available. These men were used on various odd jobs, such as painting, erecting warning signs for submarine cable location to prevent careless anchorage, replacement of timber faces on the channel piers, repairs to broken gates, etc. The cost of these chores handled in this manner was $2,717.46.

Prevention of Tubercles by Ammonia-Chlorine

During the Superintendents' Round Table Discussion at the convention of the American Water Works Association, two or three members suggested the possibility that ammonia-chlorine treatment would prevent not only dead-end taste and odor troubles, but the formation of tubercles also. One who expressed this idea was Malcolm Pirnie. We asked Mr. Pirnie for further information on the subject and received the following information in reply.

Inspection of the interior of steel water tanks at West Palm Beach shows that tuberculation does not occur above the normal water level in the tanks. This fact seemed to Mr. Pirnie to indicate that the tuberculation is probably due chiefly to biological action, although it is possible that chemical corrosion plays a minor part. A series of tests is now being initiated in an endeavor to confirm the belief that biological action is mainly responsible for the tuberculation as observed.

Mr. Pirnie's statement that the ammonia-chlorine process would probably be a remedy for tuberculation that was due to biological action is based on recent experience at Utica, N. Y., where it appears that the ammonia-chlorine process is effective in preventing tuberculation of a water supply main. The main carries water containing about 0.5 ppm of iron and in the past accumulated iron deposits at such a high rate that it was necessary to clean the main annually in order to maintain a satisfactory coefficient. This main first came to Mr. Pirnie's attention several years ago when he was studying the water company's property, and after considerable investigation he decided that biological action in the pipe was removing iron from the raw water to make the pipe line in effect an iron removal plant, thereby necessitating frequent cleaning in order to maintain the capacity of the pipe. The suggestion that ammonia-chlorine treatment might destroy the biological life and thereby obviate the necessity of frequent cleaning has been followed up and indications up to the present time are highly satisfactory.



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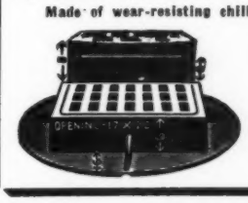

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Notes on Sewage Treatment and Trade Wastes

Salt Water in Sewage Retards Sedimentation

IN planning for sewering the Annapolis (Maryland) metropolitan area, the Metropolitan Sewerage Commission found a problem presented by the fact that the sewage contributed by the U. S. Naval Academy area contained sulphate concentrations in excess of 300 ppm., due to the use of salt water for flushing purposes; and it was feared that this might have some destructive effect on parts of the sewer system. Advice was asked of the State Bureau of Sanitary Engineering, which reported that tests made by it "indicated that in certain sections of the interceptors there was a possibility of hydrogen sulphide concentration reaching 3.0 ppm. Experience at other places has shown such an amount sufficient to cause destructive action on sewer systems at summer temperatures."

Additional effect of the salt water, the Bureau reported, would be a retarding of the rate of sedimentation. Tests made by it showed that "sewage containing salt water and having a chloride concentration of 546 ppm. and a sulphates concentration of 94 ppm. showed settleable solids in one hour of 3.0 cc. per litre. When these concentrations were increased to 1276 ppm. and 199 ppm., respectively, by additional salt water, the settleable solids in one hour dropped to 1.5 cc. per litre. Pre-chlorination increased settling rates. Sewage chlorinated to a residual of 1.0 ppm. produced 3.3 cc. per litre of settleable solids in one hour as compared with 1.7 cc. per litre in the same sewage unchlorinated. Prechlorination supplementing several methods of chemical precipitation was found to increase the removal of volatile matter from 28 to 37 percent. B.O.D. reductions were similarly increased about 15 percent by supplementing chemical treatment with pre-chlorination."

L. H. Enslow, who was employed by the Annapolis Commission to examine the results of these studies, agreed with the conclusions that provision for split chlorination of the sewage during the warm months at strategic points on the interceptors should be made and that the sewage entering the pumping station should be chlorinated during the entire year. It is not believed necessary to apply chlorine on the interceptor for the first year or two, in view of the fact that the anticipated hydrogen sulphide production is probably near the minimum concentration (3.0 ppm.) that will be destructive to the system. During this period a study of hydrogen sulphide concentrations at certain points on the interceptors is recommended.

Should the Naval Academy and Hospital authorities abandon the use of salt water there will be no necessity of chlorinating on the interceptors. However, the proximity of the pumping station to nearby residences probably requires chlorination of the incoming sewage to prevent an odor nuisance.

Tentative plans for treatment will include provision for chlorination at the junction of the Naval Academy and North Shore interceptors, possibly at another point on the system, and at the pumping station, coarse screening, settling in mechanical clarifiers and sludge digestion, followed by vacuum filtration of sludge. The adjacent truck farming area will provide for disposal of the dewatered sludge pending future developments to incinerate the sludge in a municipal garbage and trash incinerator.

Distillery Wastes Disposal

State boards of health are being asked for advice by municipalities which find that the starting of distilleries is, incidentally, starting trouble for them. In Ohio the effluents from distilleries in Cincinnati are discharged into the sewers and by them into the Ohio river, and that city will be expected to prevent this additional pollution of that river. Fostoria has a sewage treatment plant, but no water flows in the Portage river, into which the effluent is discharged, for the city uses practically all the flow for its water supply. A distillery there would certainly add to the nuisance created in the river below the city. A brewery at Wapakoneta discharges its wastes into the Anglaize which are claimed to be killing the fish. At Minster a brewery discharges into the old canal, creating a bad condition.

The Ohio State Board of Health summarizes the result of an investigation made jointly by that board and the U. S. Geological Survey some years ago:

1. From the still and rectifier of a distillery about 45 gallons of waste slop liquor are discharged for each bushel of grain mashed. This liquor contains approximately 5 percent (by weight) of solid matter, nearly half of which is held in solution. All elementary compounds of the grain are represented in full quantity, starch excepted, the greater part of this substance being separated in the manufacture of the spirituous product.

2. One part of distillery refuse discharged into a stream of moderate fall having an average flow of 150 parts of water will produce a serious pollution for a long distance below the point of its introduction and may at times render the stream waters unfit for any use.

3. By screening out most of the suspended solids, nearly 10 percent (by volume) of the slop may be converted into a dry cattle feed at a high rate of profit; an additional 50 percent may be utilized as a liquid cattle food, generally with a slight profit; in the manufacture of some liquors a considerable quantity may be used instead of water in certain processes. From 10 to 40 percent cannot be profitably used and is run to waste.

4. Stream pollution by such refuse may be wholly avoided by means of evaporation recovery of cattle feed grains from the slops. By this method of disposal the entire slop product of a distillery may be utilized, the solid matter as a feed stuff and the distillate from evaporation as water for mashing.

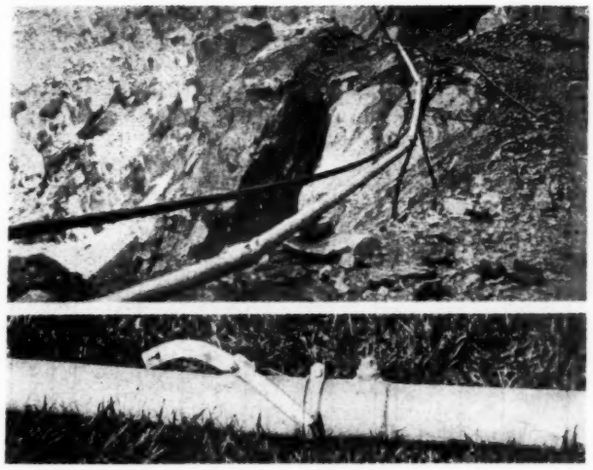
5. As applied to a distillery using daily 1,750 bushels of corn for a season of 150 days and 1,392 bushels of rye for a season of 50 days, the following data regarding the process may be accepted as approximate:

a. Cost of complete recovery plant..... $52,000
b. Annual profit over operating expenses on investment in complete plant for evaporation recovery, percent 73
c. Cost of additional plant to add evaporation to recovery by screening..... $40,000
d. Annual profit over operating expenses afforded by increased product, based on investment in additional plant to add evaporation to recovery by screening, percent..... 34

6. A practical trial of the evaporation method at Lynchburg, Ohio, substantiates all the claims made for it and indicates that it will prove to be a rather greater source of profit than had been expected.

7. This system of economical disposal of slops can probably be applied successfully to any distillery large enough to create a serious nuisance by the discharge of its waste liquors into any but the smallest of streams.

Welded Air Pipe of Light Weight and Large Diameter Adds to Drilling Efficiency



Light, large-diameter welded pipe supplying air for drills, with quick-coupling device shown in close-up below

AN IMPROVED type of air transmission pipe line has recently been developed by the Construction Department of the California Division of Highways, in conjunction with the Equipment Department, and was recently described in the official organ of the division, California Highways and Public Works.

At the various labor camps and on other major day labor projects where excavation often consists of almost 100 per cent solid rock, the problem of securing adequate and effective air pressures at the point of drilling becomes of paramount importance. Several camps operate six or more portable compressors, entailing the use of several thousand feet of pipe lines.

The transmission of compressed air through long pipe lines causes considerable drop in pressure due to frictional loss, especially if the pipe is of small diameter. For instance, a compressor with 400 cubic feet per minute capacity and a pressure of 110 pounds at the receiver, using three rock drills and the usual air hose connections on 3000-ft. of 2-in. wrought iron pipe, gives a working pressure of about 61 pounds at the drills.

This results in a very low drilling speed, a pressure of 85 pounds being most efficient. If this pipe size is increased to 2½ inches, drill pressure would rise to 92 pounds; 3-inch pipe would give 102 pounds and 4-inch pipe, 108 pounds.

The average 310 cu. ft. displacement portable compressor has a volumetric efficiency of about 70 per cent, which means it will deliver about 215 cubic feet per minute at 90 pounds pressure. A 360 cubic foot machine will deliver about 250 cubic feet, and a 310 two-stage, or one with a supercharger, will deliver the same. Altitude decreases this volume about 1½ per cent for each 1000 feet.

Portable compressors of 450 cubic feet displacement are now available; also, where there is a large amount of drilling to be done, it is not unusual to use two 310 cu. ft. compressors hooked up in tandem and regulated by one unloader; therefore the need of the larger size pipe line becomes apparent.

Another particular advantage of larger diameter pipe line is that it can be manifolded, and other smaller lines taken from it to suit the convenience of the job; it also acts as a storage tank or air reservoir, and permits much steadier working of the drills due to the volume of air it contains.

At the Kings river convict camp in Fresno County, experiments were made early in 1933 in the use of a 4-inch spiral welded galvanized air pipe, of light weight, with quick detachable couplings. This pipe is made up in 20-foot lengths, equipped with Venturi couplings and locking devices, with necessary elbows or other fittings, and 1-inch or 2-inch taps for making smaller pipe connections. This 20-foot length of 4-inch portable pipe is readily carried by one man, and can be adjusted to horizontal or vertical curves on irregular topography. Other camps are also using this type of air line, about 7200 lineal feet having been purchased to date.

The weight of a 20-foot length of 2-inch pipe, such as is in common use, is 73 pounds, of a 3-inch pipe is 151 pounds and of a 4-inch wrought iron pipe is 216 pounds.

The weight of the new type 4-inch pipe is about 75 pounds per 20-foot length, including couplers. The light weight spiral weld pipe has a safe working pressure of 250 pounds per square inch and the rapidity with which it can be coupled up is a valuable factor. Airtightness is maintained by the use of rubber gaskets of simple design.

PRESSURE ON CONCRETE FORMS

The method used by the Engineering Department of the Board of Public Works, Los Angeles, Calif., for the design of bolt ties in concrete forms is as follows:

IN BUILDING FORMS FOR CONCRETE STRUCTURES, WHERE THE PRESSURE OF THE CONCRETE MUST BE TAKEN CARE OF BY BOLT TIES BETWEEN THE FORMS, THEIR REQUIRED SIZE AND NUMBER SHALL BE CALCULATED FROM THE FOLLOWING FORMULA: $P = H^{0.2} \times R^{0.3} - 0.3\,S + 0.12C$, (FROM BUREAU OF PUBLIC ROADS) WHERE P = PRESSURE IN POUNDS PER SQUARE INCH ON FORMS, H = HEAD OF CONCRETE IN FEET TO BE POURED IN 45 MINUTES; R = RATE OF POUR IN VERTICAL FEET PER HOUR; C = RATIO BY VOLUME OF CEMENT TO AGGREGATE IN PERCENT, AND S = SLUMP IN INCHES.

H	$H^{0.2}$	R	$R^{0.3}$	S	$0.3S$	MIX	C	$0.12C$
1	1.00	1	1.00	1	0.3	1-2-3	20.0	2.4
2	1.15	2	1.23	2	0.6	1-2½-4½	18.2	2.2
3	1.24	3	1.39	3	0.9	1-3-5	12.5	1.5
4	1.32	4	1.52	4	1.2	1-3-6	11.1	1.3
5	1.38	5	1.62	5	1.5	1-4-8	8.9	1.1
6	1.43	6	1.71	6	1.8			
7	1.48	7	1.79	7	2.1			
8	1.52	8	1.87	8	2.4			
9	1.55	9	1.93					
10	1.59	10	2.00					

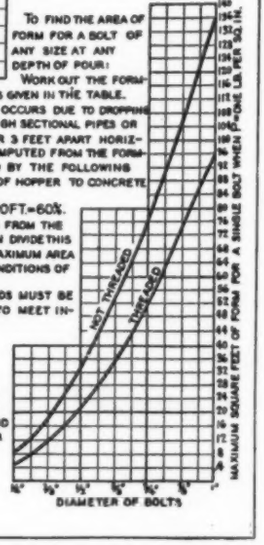
TO FIND THE AREA OF FORM FOR A BOLT OF ANY SIZE AT ANY DEPTH OF POUR: WORK OUT THE FORMULA USING VALUES GIVEN IN THE TABLE.

WHERE IMPACT OCCURS DUE TO DROPPING CONCRETE THROUGH SECTIONAL PIPES OR CHUTES INTO FORMS UNDER 3 FEET APART HORIZONTALLY, THE PRESSURE COMPUTED FROM THE FORMULA SHALL BE INCREASED BY THE FOLLOWING PERCENTAGES FOR DROPS (MEASURED FROM TOP OF HOPPER TO CONCRETE IN FORMS) INDICATED BELOW

5 FT. = 0%; 10 FT. = 20%; 15 FT. = 40%; OVER 20 FT. = 60%.

HAVING DETERMINED THE VALUE FOR P, READ FROM THE PROPER CURVE THE AREA OF FORM FOR P = 1, THEN DIVIDE THIS AREA BY THE VALUE OF P. THIS WILL GIVE THE MAXIMUM AREA TO BE HELD BY THAT SIZE BOLT UNDER THE CONDITIONS OF THE FORMULA.

DIMENSIONS AND SPACING OF WALES AND STUDS MUST BE CALCULATED TO INSURE PROPER STRENGTH TO MEET INDICATED PRESSURE.



NOTE —
THE LOWER CURVE IS FOR THREADED BOLTS. THE UPPER CURVE IS FOR UNTHREADED BOLTS.
THE WORKING STRESS OF WROUGHT IRON AND STEEL BOLTS TAKEN AT 25000 POUNDS PER SQUARE INCH.

Traffic Counts on Kentucky Highways

By J. L. Donaldson
Kentucky State Highway Commission

DURING the summer of 1933 a traffic survey was undertaken in District No. 5 of the Kentucky State Highway Department. This district is located in the north central part of the state, and includes the counties of Boone, Kenton, Campbell, Pedleton, Grant, Owen, Gallatin, Carroll, Henny, Trimble and Oldham.

Purpose of Survey

The primary purpose of this survey was to determine the kind and volume of traffic which representative highways carried during the summer months, so that facts rather than guesswork could be used as a guide in planning, constructing and maintaining the highways within the district.

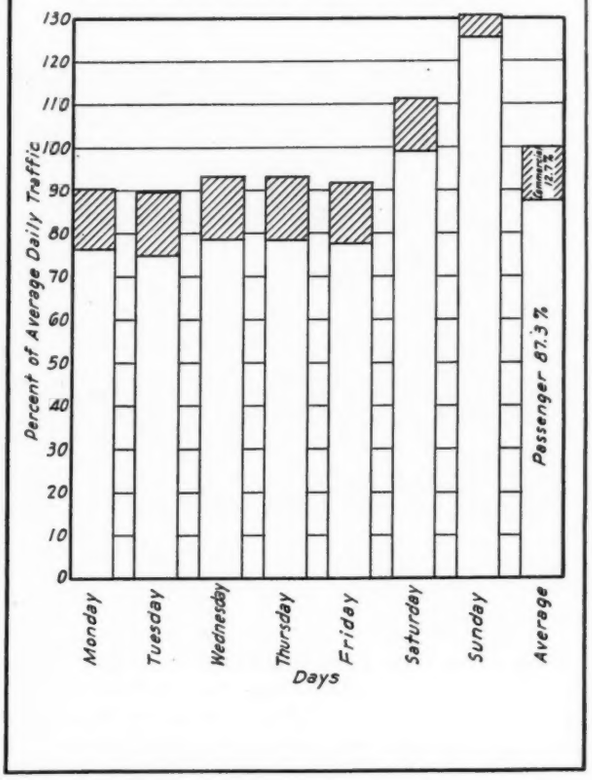
The secondary purpose was to study the characteristics or habits of traffic to obtain a better understanding of some of the fundamental principles governing traffic flow. Such information is invaluable as a guide for future traffic studies.

No attempt was made to make this an extensive traffic survey that would give data on every highway within the district. Only typical highways that would give a representative cross-section of the traffic within the district were selected for study. It is planned to continue the collection of such data this year and it is hoped that ultimately information will be secured on all the highways of the district.

Location of Stations and Method of Counting

With these purposes clearly in mind, traffic counting stations were selected to give representative results. Only two men were used to collect the field data. With one exception the traffic passing each station was counted for a full week, 16 hours each day, the men then moving to the next nearest station. By this method two men were able to tabulate the counts at 20 stations from June to October, at a cost of approximately $100.00 per station. From a study of the data collected last year and the experience gained in collecting them, we are confident that a material saving in cost can be realized in the studies proposed for this and future years.

Figure "A"
DAILY VARIATION OF TOTAL TRAFFIC EXPRESSED AS PERCENTAGE OF TRAFFIC DURING AVERAGE DAY



Station No. 1 was counted for a full 24-hour period each day; but all other stations were counted only 16 hours from 7 A. M. to 11 P. M. each day, and the per cent of total 24-hour traffic passing Station No. 1 during the hours of 11 P. M. to 7 A. M. was computed and this factor applied to all other 16-hour counts so that all results would be on a full 24-hour basis.

All of the data were recorded by hours and separated into local, state and foreign as well as passenger, bus and truck traffic. The truck traffic was further subdivided into two classes: under, and over, three tons capacity.

PERCENTAGE OF LOCAL, STATE AND FOREIGN TRAFFIC

Average Daily Traffic for Week (Incl. Sat. and Sun.)		*Ratio of Commercial*	PASSENGER			COMMERCIAL			TOTAL TRAFFIC		
Station Number	*Total*	*to Total Traffic*	*Local*	*State*	*Foreign*	*Local*	*State*	*Foreign*	*Local*	*State*	*Foreign*
1	9,177	12.4%	54.5%	17.2%	28.2%	45.8%	30.8%	23.4%	53.4%	18.9%	27.7%
2	7,070	12.9	73.5	9.6	16.9	62.2	14.8	23.0	72.0	10.3	17.7
3	4,311	11.2	64.5	16.6	18.9	54.5	30.1	15.4	63.5	18.1	18.4
4	1,909	11.6	60.0	19.2	20.8	48.7	24.2	27.1	63.5	18.1	18.4
5	1,869	11.5	33.8	28.8	37.4	35.2	39.0	25.8	34.0	30.0	36.0
6	1,729	11.3	74.7	9.3	16.1	78.7	9.9	11.4	75.1	9.3	15.6
7	1,369	14.6	19.2	36.6	44.2	18.0	51.2	30.8	19.1	38.8	42.1
8	741	11.3	59.6	24.8	15.6	49.9	36.7	13.4	58.4	26.2	15.4
9	725	17.4	35.4	42.0	22.6	45.1	30.6	24.3	51.0	31.2	17.8
10	679	23.3	63.1	25.2	11.7	45.0	47.4	7.6	58.9	30.4	10.7
11	529	9.5	72.6	20.9	6.5	43.0	49.6	7.4	69.8	23.6	6.6
12	508	15.9	51.6	42.3	6.1	49.6	45.8	4.6	51.2	43.0	5.8
13	500	13.2	52.3	28.5	19.2	37.2	47.8	15.0	50.3	31.1	18.6
14	468	15.5	62.7	17.3	20.0	57.0	32.6	10.4	61.8	19.7	18.5
15	366	13.5	37.0	46.0	17.0	34.6	54.4	11.0	36.6	47.2	16.2
16	298	14.0	69.8	23.4	6.8	59.4	35.8	4.8	60.2	25.2	6.6
17	292	14.8	71.3	19.1	9.6	51.5	36.1	9.4	68.6	21.8	9.6
18	278	14.7	43.8	39.2	17.0	37.5	47.7	14.8	42.9	40.4	16.7
19	151	12.6	43.9	47.3	8.8	39.6	55.0	5.4	43.4	48.2	8.4
20	40	21.3	59.3	38.6	2.1	39.2	53.0	7.8	55.0	41.7	3.3
Weighted Average		12.7%	58.5%	18.8%	22.7%	49.8	29.9	20.3	57.4	20.2	22.4

Average Week Day Traffic

Fig. A shows the average variation for each day of the week for all the stations counted. From the uniformity of the Monday-Friday volumes, it is apparent that it is unnecessary to count the traffic each of these days. Any *normal* day between Monday and Friday may be counted and this assumed to be the average for this period without materially effecting the accuracy of the results. While it is true that some individual station counts showed a greater daily variation from Monday to Friday, yet if the abnormal and subnormal counts were eliminated the variation would be small. This fact, which has also been borne out by numerous counts in other states will permit either more stations to be counted for the same money or the same stations for a material reduction in cost.

Saturday and Sunday Traffic

It is common knowledge among all motorists that the Saturday and Sunday traffic is greater than the average week day. This increase was found to be due almost in every case to the increase in passenger traffic, as the commercial traffic was less on Saturday than the average week day while Sunday showed only a trace.

It will be noted that the relation between the total Saturday traffic and the average week day is more constant than between the Sunday traffic and the average week day. This is due no doubt to the fact that Sunday traffic is almost entirely pleasure, and is influenced more by weather conditions and seasonal differences.

It is evident that, after the relation between the Saturday and Sunday traffic to the average week day has been ascertained by a number of representative counts within the area, the actual counting of the traffic on Saturday and Sunday may be omitted. By applying the proper factor to a *normal* week day count, both the Saturday and Sunday traffic may be computed, without introducing any serious error. This materially reduces the field work as well as the cost of collecting the data.

Commercial Traffic

Referring to Table I it is seen that the ratio of commercial to total traffic is fairly constant for all the stations counted. Only a few counts vary materially from the weighted average of 12.7%. All of those variations can be explained by local conditions. For instance Station No. 10, where the commercial traffic is 23.3% of the total, is within one mile of one of the largest tobacco markets in Carrollton. More than 12 million lbs. of tobacco are delivered to this market each year in trucks. At Station No. 11, where the commercial traffic is 9.5% of the total, can be explained by the fact that this road serves a rural community with little commercial transportation.

Bus traffic varies greatly at the various counting stations. This is a natural condition depending upon whether regular scheduled bus routes are operated over a particular highway. Such traffic is generally confined to highways connecting large centers of population such as Lexington and Cincinnati, or Louisville and Cincinnati.

The per cent of trucks over 3-ton also varies materially at the various counting stations, depending on the character of the area whether industrial or rural. From the table is seen that at station No. 7 the percentage of trucks over 3-ton is 18.0%, while the weighted average for all the stations counted was only 7.9%. The close proximity of the Carrollton tobacco market to this station explains this heavy truck traffic.

Local, State and Foreign Traffic

The State Highway Department is frequently requested to take over for maintenance and construction certain section of highways from the local governing bodies, on the grounds that the traffic is largely non-local. Without actual traffic data it is largely the opinion of one man against another. The table shows the use made of the various highways classified into Local, State and Foreign traffic, and further subdivided into Passenger, Commercial and Total.

Over half of the total traffic counted was local traffic. There are, however, wide variations in the composition of traffic on the various routes studied. The greatest per cent of foreign traffic was found on U. S. 42 and U. S. 25, the principal routes across the state connecting Indiana and Ohio.

Conclusion

The value of traffic counts has been clearly demonstrated by this survey. The data so far collected and studied have given us a clearer conception of the traffic needs of District No. 5. While originally intended only as a means of determining relative maintenance costs of various types of road surfaces under various kinds and volumes of traffic, as an aid to future planning and construction, many more uses have been found. It is the duty of every highway official to plan, design, construct and maintain the highways under his jurisdiction in an efficient and economical manner. This can only be accomplished by a knowledge of the kind and volume of traffic using the highways. By employing short count methods the cost of such studies are now within reach of every highway engineer.

RELATION BETWEEN AVERAGE WEEK DAY, SATURDAY AND SUNDAY TRAFFIC

	Average Week Day Traffic Monday to Friday		Saturday Traffic			Sunday Traffic			Percentage of Total Average Daily Commercial Traffic			
										Trucks		
Station Number	*Passenger*	*Commercial*	*Passenger*	*Commercial*	*% of Av. Week Day*	*Passenger*	*Commercial*	*% of Av. Week Day*	*Under 3 tons*	*Over 3 tons*	*Busses*
1	7,223	1,316	8,617	1,004	1.13	11,507	425	1.40	85.4%	5.8%	8.8%
2	5,660	1,027	6,690	915	1.14	8,120	330	1.26	90.1	5.3	4.6
3	3,426	542	4,460	455	1.24	5,210	214	1.37	86.5	11.6	1.9
4	1,424	243	1,879	194	1.24	2,820	101	1.75	83.7	11.8	4.5
5	1,351	230	1,954	236	1.38	2,875	114	1.89	78.5	14.0	7.5
6	1,422	205	1,668	210	1.15	1,847	128	1.21	77.9	2.6	19.5
7	964	213	1,317	223	1.31	2,045	86	1.81	71.5	18.0	10.5
8	586	93	734	88	1.21	942	37	1.44	90.4	3.6	6.0
9	558	137	719	121	1.21	682	76	1.09	68.2	6.4	25.4
10	439	187	704	159	1.38	751	14	1.22	93.1	6.3	0.6
11	418	59	888	44	1.95	377	7	0.80	88.0	10.0	2.0
12	347	91	477	85	1.28	786	20	1.84	84.0	11.1	4.9
13	341	79	622	44	1.58	712	13	1.73	89.4	10.6	
14	343	81	325	58	0.90	726	47	1.82	90.4	9.6	
15	257	53	399	51	1.45	530	31	1.81	85.7	6.1	8.2
16	190	49	467	42	2.13	373	5	1.57	88.1	7.1	4.8
17	205	49	335	37	1.46	382	14	1.55	88.4	11.6	
18	198	48	249	43	1.19	416		1.69	80.4	9.8	9.8
19	93	18	160	34	1.75	301	9	2.79	94.7	5.3	
20	29	10	44	5	1.26	35	5	1.03	100.0		
Weighted Average					1.22			1.43	85.2	7.9	6.9

Municipal Engineers and Public Works Officials

Meet at Rochester, N. Y., in a Joint Convention of Three Associations

THE American Society of Municipal Engineers held its 40th annual convention in Rochester, N. Y., September 24th to 27th, and the International Association of Public Works Officials held its 15th at the same place September 26th to 28th; meetings on the 26th and 27th being held jointly by these two organizations. Also the New York State Association of City and Village Engineers held its business meeting in Rochester on the 26th. Except for the business meetings of the several societies, all meetings of each were open to and quite generally attended by members of all three societies, more than two hundred of whom registered at convention headquarters.

The joint meetings of the A. M. E. and the I. A. P. W. O. gave expression to a feeling among some, at least, of the members of both societies that their interests are largely common and that there should be a large measure of cooperation between them, if not amalgamation. During the convention a still further step was taken in the same direction by the selection of the same secretary to serve both societies during the coming year. It was the general opinion of members of the two societies who were present at Rochester that, for the present at least, there should be no amalgamation of them, but an effort to determine what advantages, financial and otherwise, there might be in maintaining a joint secretariat, which will be located in Chicago.

The Chicago location possesses the advantage of propinquity to the headquarters of several other organizations having allied interests, such as the "City Managers Association," several national organizations of mayors, state legislators, etc., and "Public Administration Clearing House"; which seems to offer, or at least suggest the possibility of, mutual advantages and the development of a better appreciation by each of the other's viewpoint toward public works, finances and other municipal, state and federal matters. It is the idea of the officers and directors of the two societies that this temporary joint secretariat should study this question with a view to submitting a plan to the membership for their acceptance or rejection within the next few months.

This was the only important business matter before this meeting of the A. M. E., except two proposed amendments, which are to be submitted to letter ballot; one which provides for amending the constitution by letter ballot between conventions (which is not now possible); the other which permits local chapters to carry chapter members not subject to the membership requirements of the national organization, and retain in the chapter treasury all the dues of such members; which members cannot hold office.

The officers of the A. M. E. for the coming year are: Harrison P. Eddy, Jr., President;; Bryson Vallas, First Vice-President; Geo. B. Gascoigne, Second Vice-president; Thomas Buckley, Third Vice-president; Henry L. Howe, National Treasurer; Donald C. Stone, Executive Director.

During the year the society suffered a net loss of 55 members (9 by death), which is about 7% of the membership—much less than many societies have suffered during the depression. The balance in the treasury is slightly more than a year ago.

At the banquet, (at which 217 were present), as has become the annual practice, presentations of the Greeley Veterans Award were made; this year to W. R. Tenney, chief engineer, Bureau of Highways, Brooklyn, N. Y., in recognition of 33 years of continuous service as engineer for that city; to A. K. Johnson, chief engineer of highways, Borough of Queens, New York City, for 28 years of service; and to P. L. Brockway, city engineer of Wichita, Kans., who has been 26 years with that city.

The new officers of the I. A. P. W. O. are: Alfred E. Roche, President; Mark B. Owen, First Vice-president; J. Eugene Root, Second Vice-president; John S. Flockhart, Third Vice-president; E. A. Miller, Treasurer; A. M. Anderson, Secretary, and Donald C. Stone, Executive Secretary.

The meetings of the societies were notable for the consideration given to matters of finance, administration and national problems, and the small number of papers and meagre discussions on technical matters. "New Angles in Water Works Practice" by Paul Hansen; "The Turn to Low-Cost Pavements" by Samuel Eckels; "New Departures in Pavement Maintenance" by Geo. Sandenburgh; "A Year's Experience in Sewage and Sanitation" by Louis R. Howson; "A Modern Method of Sewage Treatment" by Mark B. Owen; and discussions on Reduction and Incineration of Refuse and on Hog Feeding comprise the technical discussions of both societies at all meetings. Relief activities, housing, national planning, management, finances—these and kindred matters received most of the attention of the delegates.

Col. Henry M. Waite, until recently FERA deputy administrator, said: "The great need of the country today is to think in broad terms of planning—federal, state, county, district or drainage area. The city engineer should participate in this job. . . . Today there is great opportunity for engineers with imagination enough to look into the future fairly."

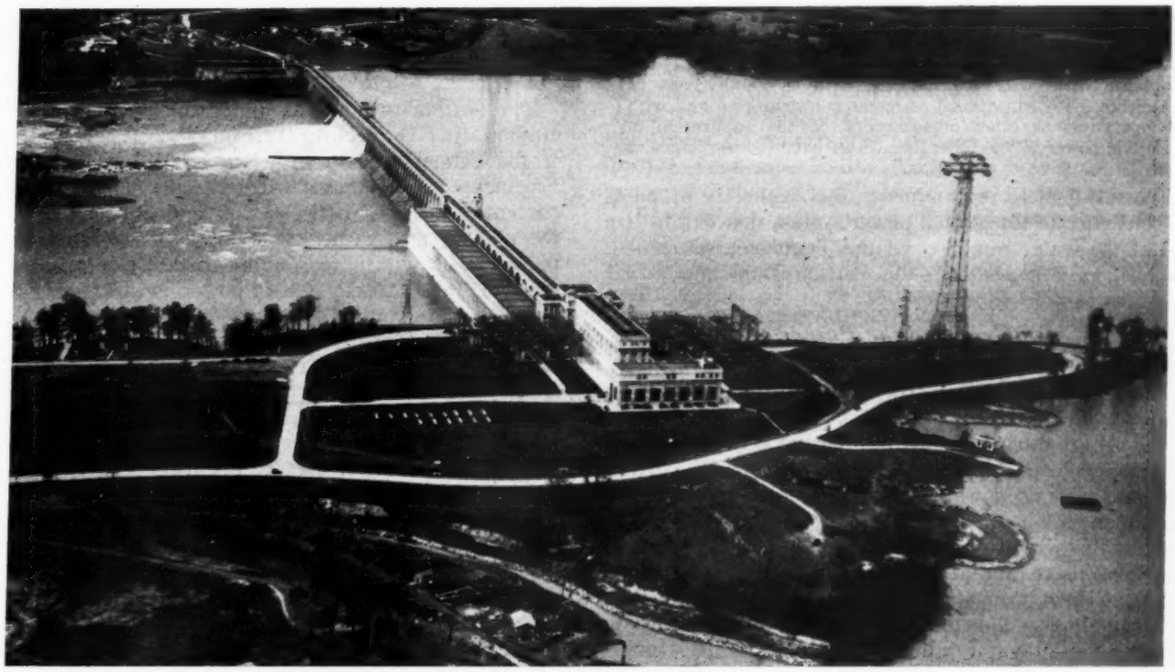
The term "city planning," said Thomas Buckley, assistant chief engineer, Philadelphia, has become associated in the popular mind with elaborate planning for the distant future, or with embelishments rather than necessities, which should be forgotten during the present depression in municipal finances. He suggests the substitution of the term "city development," and the explanation that cities are bound to develop and that it is better that they develop according to some plan than haphazard.

Several of the technical papers will appear in later issues of PUBLIC WORKS in full or in abstract. Among some of the outstanding statements made in them are the following: Samuel Eckels, chief engineer Pennsylvania State Highway Department, said that a low-cost pavement should not be made so solely by selection of type of construction, but should not be over 14 ft. wide. Also that the low cost should not be confined to construction, but should apply to maintenance also. Also it should be realized that what is a low-cost type of construction in one locality may not be so in another where similar aggregate or other materials are not available or weather conditions are different.

Referring to obtaining Federal funds or others for sewage construction, Louis R. Howson said that 26 states now have laws providing for issuing sewer revenue bonds. Speaking of activated sludge patents, he said that the Chicago case has not been decided yet and no definite statement can be made on how patent suits will affect other plants or future construction.

Water Light and Power

A Special Supplement to PUBLIC WORKS *magazine devoted to the interests of publicly owned utilities.*



Wilson Dam seen from the air. Power house is on this end. Navigation locks being built on other end.

Electric Power from the Tennessee Valley

First of a series on the gigantic TVA development, this article describes the program to extend the use of electricity.

By W. L. Sturdevant
Director Information Division, Tennessee Valley Authority

THIS article deals primarily with the hydro-electric power program of the Tennessee Valley Authority, a governmental corporation created by Act of Congress, for the development of the water resources of the Tennessee basin. This act provides for completing the power development project at Muscle Shoals; for developing newer and better forms of plant food, or fertilizers; for building transmission lines, reflecting President Roosevelt's desire to have somewhere in America a "yardstick" of public transmission of power by which to measure the effectiveness of the private power industry; and there are provisions for flood control, for navigation, for afforestation, for agriculture, and a host of other things.

A careful examination makes clear that all of this is not an accidental bundle of purposes, but that, after considerable debate, Congress prepared a clear-cut expression of a definite and far-reaching plan, in which these various activities tie together into a single integrated plan for the development of a region some 42,000 square miles in area, and by which haphazard, unplanned and unintegrated social and industrial development may be displaced by introducing increasing elements of order, design and forethought.

It is the President's hope that the Tennessee project may develop methods and policies for bringing industrial and social order out of the haphazard growth that has characterized our national life, with the prospect that if they should develop soundly and successfully here, those same policies might have wider application in other parts of the country.

The Act provides very specific instructions covering the electric power phase of the Authority's program. Under Section 10 is the following statement:

> "The board is hereby empowered and authorized to sell the surplus power not used in its operations . . . to States,

counties, municipalities, corporations, partnerships, or individuals; . . . and in the sale of such current by the board it shall give preference to States, counties, municipalities, and cooperative organizations of citizens or farmers, not organized or doing business for profit, but primarily for the purpose of supplying electricity to its own citizens or members."

In order to further the use of electricity in rural sections, the Authority is authorized to erect transmission lines wherever feasible.

Continuing, the Act states:

"The board is hereby authorized and directed to make studies, experiments, and determinations to promote the wider and better use of electric power for agricultural and domestic use, or for small or local industries, and it may cooperate with State governments, or their subdivisions or agencies, with educational or research institutions, and with cooperatives or other organizations, in the application of electric power to the fuller and better balanced development of the resources of the region."

To fulfill these requirements, the Authority proposes to construct an integrated power system that will utilize all of the water resources of the Tennessee watershed. It has, as a beginning, the Wilson Dam and power plant at Muscle Shoals.

Creating the Power

The Wilson power plant is what is called a "run-of-the-river" plant; that is, there is very little storage of water in the lake above the dam. When the Tennessee river is high during the winter, there is water enough to develop considerable horsepower. During the driest summer seasons, however, the flow is small, and there is water enough to generate only about 50,000 h.p. To correct this wide variation of flow, the new Act provides for the construction of the Norris Dam and power plant on the Clinch river more than 200 miles upstream from Muscle Shoals. This dam will create a storage reservoir great enough to store almost a year's rainfall. During the winter, when the river is high and power is abundant at the Shoals, the Norris Dam plant will be shut down and the water stored in the reservoir. During the summer, when the river is low and power is scarce, the Norris Dam power plant will be operated. The water released during the generating of power at the upstream plant will flow down to the Wilson plant at Muscle Shoals, where it will be used a second time to develop more power. Thus the two dams operated as a single system will generate five or six times as much dependable power as either one could if operated alone.

In addition to the Norris project, the Authority is building the Wheeler Dam, located on the Tennessee 15½ miles above Wilson Dam. When these are completed in 1936, the Authority will have in operation three plants to supply its power requirements. And others are planned.

These developments will not only generate power, but also make navigation possible throughout the year and reduce flood dangers.

Distributing the Current

The Authority now has under construction a transmission line connecting Wilson and Wheeler Dams on the Tennessee river with Norris Dam on the Clinch. Engineers believe that it will be economical to transmit current a distance between 200 and 300 miles. It is the plan of the Authority to supply power first of all to the areas within reasonable distance of this transmission line. Muscle Shoals power is now being supplied to nine counties in northeastern Mississippi, to 13 towns in northern Alabama, and in the near future it will be lighting homes and farms in portions of East Tennessee.

In line with the Congressional desire to promote the operation of municipally owned plants for the benefit of the citizens, the Authority is aiding cities and towns in the acquisition of distribution facilities if by popular referendum such municipalities desire it. Knoxville, Tennessee, offers a typical example of how the Authority is doing this.

The Tennessee Public Service Company owned the Knoxville system. In November, 1933, the citizens of Knoxville voted for a municipal plant and authorized the issuance of bonds for this purpose. As it is the policy of the Authority to avoid duplication of facilities if it is at all possible, it made every effort to buy the system from the Tennessee Public Service Co., with a view toward reselling it to the City of Knoxville. This was accomplished. The Authority purchased the facilities of the private utility not only in Knoxville, but also in the adjacent territory. It will resell to Knoxville that portion of the distribution system within Knox County, and will eventually resell the balance to other neighboring communities. In the case of Knoxville, the Authority will be reimbursed out of profits and a ten per cent surcharge that will be levied on bills. It is estimated that between ten and fifteen years will be required to repay the Authority. In this way the people of Knoxville will acquire their own power plant and will not have to issue any bonds to do so. And in the meantime they will be getting the benefit of cheap TVA current.

In Alcorn County, Mississippi, the same process was used, except that in the case of Alcorn the agency that will rebuy the distribution facilities is an asso-

View of construction of Norris Dam from west abutment

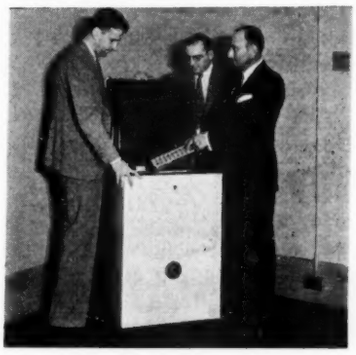
ciation of citizens of that county, instead of a particular community.

Recently the Authority purchased from the Alabama Power Co. the distribution facilities in thirteen North Alabama cities and towns, which will get TVA power and will repay the Authority for the monies the latter have expended. It is the policy of the Authority, when acquiring existing lines, to pay the selling utility a price that will protect sound investment in useful property.

Developing Use of Electricity

Two barriers have stood in the way of a widespread use of electricity. The first and most important barrier is the rates charged for electricity, which have been too high to permit of its general use, which use therefore has never, except in unusual communities, reached the proportions justified by the universal need and effective demand for this service.

REFRIGERATOR APPROVED BY TVA



The new lift-top model electric refrigerator developed by the Westinghouse Electric & Manufacturing Company is one of the types which have been approved by the Tennessee Valley Authority. As a result, it will carry the emblem of the Authority and will be financed in TVA territory. Retailing for $77.50 f. o. b. factory, with the option of a five-year guarantee for $7.00 additional, this model typifies the type to be distributed throughout the TVA district. In the picture, left to right, are: George D. Munger, commercial manager of the EHFA, W. B. Creech, dist. supervisor of Westinghouse, and R. C. Cosgrove, Westinghouse refrigerator manager.

The electric power industry has consistently stated that if the consumers would use more electricity the rates could be greatly decreased. One leader among the utility executives, for example, pointed out that his most profitable customers were those who, with a completely electrified home, are charged a rate of less than 2 cents per kwh, as compared with the average user's rate of 4½ cents and the small user's rate of 8 cents. Increase in use is essential to bring down unit costs, but to increase the use, the rates to the consumers must be decreased.

The second barrier to wide-spread use is the relatively high cost of electric appliances. The labor and material costs of electric appliances have always been but a fraction of the total retail price. Volume production could have brought greatly decreased prices to the ultimate consumer, but with electric rates on a luxury basis, volume production of electric appliances in this field has never been accomplished.

Here we have a picture of a complete business stalemate. The electric utilities' position is that rates cannot be drastically decreased until the use of electricity is greatly increased which increase will not occur unless electric appliances come into general use, which is concededly impossible on the basis of present prices. The electric appliance manufacturers, on the other hand, say that unless electric rates come down, volume production of electric appliances is impossible, and without volume production, the per unit cost of manufacture and distribution cannot be substantially reduced. Electric utilities, electric manufacturers, and consumers all suffer from this vicious circle: the electric utilities, because they have great excess capacity which is idle and against which fixed charges are continuing to pile up; the electric manufacturers, because they have idle capacity on which overhead continues to be incurred. Here was an opportunity for government, represented by the Tennessee Valley Authority, to act as a stimulator and coordinator in its relation to business.

Some months ago, by Presidential order, the Electric Home and Farm Authority, an agency of the Tennessee Valley Authority, was created. The EHFA is a credit agency. It does not manufacture or sell any appliances. It has, with the cooperation of manufacturers of appliances, with the retail sellers of such appliance , and with electric utilities, publicly and privately owned, devised a plan by which the base of appliance sales is being widened. The manufacturers, recognizing that they would get mass production, agreed to put on the market at less than the current prices high-grade appliances which meet the TVA specifications and carry the TVA stamp of approval, and existing dealers agreed to sell the appliances; both manufacturer and retailer make a fair profit from each sale. When credit is desired by the purchaser, the Tennessee Valley Authority, through the Electric Home and Farm Authority, pays the retailer in full, and then arranges with the utility to collect small monthly installments, which are added to the amount of the monthly bill for current consumed.

Meantime the Authority is conducting in areas now served by TVA power, or by power from private utilities whose rates have been materially lowered, an intensive educational program demonstrating to the housewives of the Valley the most economical uses of electricity. Demonstrations of the proper methods for the use of the appliances are being held, and in every way the message of electricity is being carried into the homes and to the farms. In every instance where the Authority takes over an existing distribution system, it is extending the lines into areas that were not being served. Many miles of rural lines have been built; many more miles will be built.

A considerable number of farmers are today receiving the benefits of cheap TVA power, but the number is only a fraction of those who will be served when Norris and Wheeler Dams are completed. Highways in cities such as Tupelo, first municipality to buy TVA power, are being lighted; but again, the number of highways to be lighted by TVA power is now fractional compared with the immediate future.

All TVA power now being sold is being generated at Wilson Dam, which furnishes a supply adequate for the present needs. In addition, there is a steam plant at this dam, in stand-by condition, which may be used at a moment's notice.

The power policy of the Authority and its basic rates will be given in the next issue of PUBLIC WORKS.

Seattle Water Department Nets $169,379

City has $18,994,516 surplus, $9,125,000 in outstanding bonds and gross revenue of $1,572,234.

SEATTLE, Washington, population about 500,000, is supplied by a municipal plant with water from the Cedar river watershed, of which 2,512 acres have been reforested by planting trees grown in a municipal nursery. From the watershed, pipe lines with a capacity of 200 mgd. bring the water to Lake Youngs, where it is diverted into three pipe lines which distribute it to six reservoirs in the city with a combined capacity of 334,000,000 gallons. There are also thirteen standpipes and tanks with a combined capacity of 10,220,000 gallons. The consumption in 1933 averaged about 40 mgd, of which about 6 mgd was pumped for high service at ten pumping stations having a combined pumping capacity of 58 mgd.

Practically all services are metered, the non-metered service revenue being only $7,851, while the revenue from meters was $1,412,966. The revenue from municipal service was $82,936 ($70,247 of which was for fire protection), and $27,009 was derived from tap connections and shut-off charges. There was also a revenue from rentals and miscellaneous of $14,652, and from interest on investments of $29,059. The total revenue was $1,572,234.

The operating expense was: For supply, $74,673; for distribution, $81,471; commercial (meter reading, accounting, collecting, etc.) $104,073; general, $83,126. A depreciation of $555,919 is charged off; interest, etc., totaled $371,753; $66,183 was paid in taxes ($49,183 was a city occupational tax); and engineering and other non-operating miscellaneous expenses, $27,880. The total expense was $1,402,855, leaving the net income $169,379.

Accrued depreciation to date is $6,737,544, based on an average rate of 2.064% on buildings, fixtures and grounds, and 1.828% on equipment, the latter varying from 1% on certain aqueducts and mains to 20% on utility equipment and house furnishings. The largest item is on $13,000,000 of distribution mains at 1½% to 8⅓%.

The assets comprise $26,424,612 for plant, land and other fixed assets; $463,978 in sinking, redemption and special funds; $323,855 cash and $1,087,531 other current assets, and $346,427 miscellaneous assets; a total of $28,646,402.

The liabilities comprise $9,125,000 outstanding bonds, $432,100 current liabilities, $33,554 taxes, $50,712 deferred liabilities, and $10,521 consumers' advance payments on services. This gives a surplus of $18,994,516, of which $364,610 is in reserves for bond sinking and redemption funds and depreciation fund.

A total of 80,591 meters were in service at the end of the year. During the year 7,510 were repaired at a cost of $13,830; these meters having been in use an average of 53 months. The percentages of the total of each size which were repaired were: ½-inch, 10%; ¾-inch, 9%; 1-inch, 10%; 1½-inch, 7%; 2-inch 8%; 3-inch, 7%; 4-inch, 4%; 6-inch, 3%.

The average cost of water delivered was 6.147 cts. per 100 cu. ft., of which 3.882 cts. was operating and maintenance and 1.768 fixed charges. The revenue was 7.33 cts. per 100 cu. ft.

The principal rates were: 50 cts. per month for 500 cu. ft. or less and 6 cts. per 100 cu. ft. for all over 500 cu. ft.; except that manufacturers and certain others pay 4 cts. for all over 30,000 cu. ft. Consumers outside city limits pay approximately double these rates. Installing services is paid for by the consumer, but the cost of the meter and its maintenance are borne by the department.

Water Consumption Data at Marshall, Mo.

The city of Marshall, Mo., which has a population of 8,000, sold 101,948,180 gallons of water during 1933, a total of 279,310 gallons per day, or 35 gallons per capita per day. The municipal use (fires, sewers and street cleaning) amounted to 4,984,825 gallons; flushing fire hydrants required 2,400,000 gallons; unaccounted for water totalled 14,854,155 gallons. The total pumped was 124,867,160.

Of the operating revenues charged, which amounted to $48,882.68, all was collected except $21.51—99.96%. Improvements to the plant are now being made, the contract for constructing a small chemical building just having been let at a cost, including all materials and equipment, of $6,000.

The months of maximum consumption are July, August and September, which have, respectively, 10.00%, 10.50% and 10.74% of the total consumption. The months of least consumption are March and April, with 6.85% and 6.86%, respectively, of the total consumption.

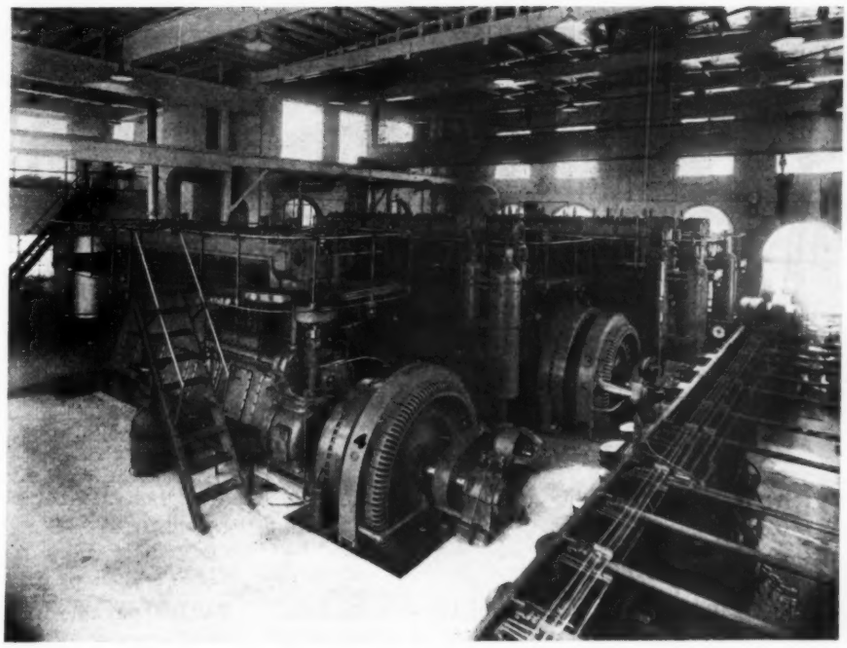
Municipal Electricity in Hingham, Mass.

Hingham, Mass., a town three hundred years old with a population of about 7,000, furnishes electric light and power, purchasing the current and selling it to its citizens and to the town for street lighting. For the year 1933 it had a net profit of $14,067 with a total sales income of $116,780; which profit is carried in surplus account.

During that year it paid $70,150 for current purchased, and sold it for $116,780. Its operating expenses totaled $20,216; it charged $6,610 to depreciation (3% of the plant value), $804 to inventory adjustments, and transferred $5,000 to the town treasury. Its surplus at the end of the year was $151,636.

It furnishes the street lighting at cost (total operating expenses divided by total kwh sold), which was calculated to be 3.406 cts., giving the cost of street lighting last year $9,207.

The light board, in its annual report, says: "Aside from the large earnings which our plant has always made for the town, the saving in street lighting alone is approximately equal to any taxes which could be collected from a privately owned plant."



General interior view of Hudson, Mass., Light and Power plant showing 1200 H.P. diesel engine in foreground.

Modernized Hudson Power Plant Produces Current for 9.74 Mills per K.W.H.

Output increases 162% in 10 years with only 12% increase in expenses, while amount of electricity given average customer for $1.00 increases 2 1/3 times.

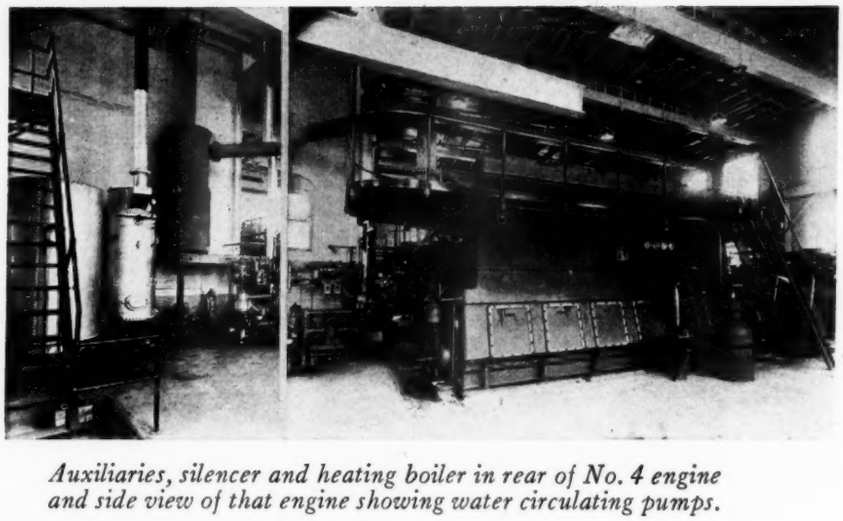
By Leland D. Wood
Manager Light and Power Dept. of Hudson, Mass.

HUDSON, Mass., is a typical New England manufacturing town, located in the hills between Boston and Worcester, and about thirty miles west of Boston. The town proper has a population of about 8500, but this department also supplies electricity to the town of Stow, and to a limited extent to other towns surrounding Hudson, so that the department supplies a total of about 10,000 population. The population is largely made up of workers in the various factories, the majority of whom own their homes. This fact shows that, while the people as a whole are very industrious, yet they are to a large extent people of limited income. This condition enters quite largely into the use of electricity for domestic purposes.

The principal industries of the town are leather footwear, rubber footwear, high-grade machine tools, and woolens. The town has been very fortunate during the past ten years, in that the management in these factories has been of such an order that at no time has the town seriously felt the depression.

The government of the town is what is known as the Massachusetts Town Form, all of the voters meeting once a year, in March, in the town hall to transact the business for the coming year and elect officers. The general supervision of the town is vested in a board of three selectmen, one elected each year for a term of three years. In 1909 an act was passed by the legislature and accepted by the town, creating a Board of Public Works, under which were consolidated the old Municipal Light Board, Sewer Board, and Water Board, together with the Superintendency of Streets. This board has the general supervision of all of these utilities. By law, the Light and Power Department is under the control of the manager appointed by this board. The other three departments, Street, Sewer, and Water, are all grouped together under another superintendent, and are operated separately from the Light and Power Department, although both departments use the same offices in the town hall. This type of control is unique in Massachusetts, and has worked out very well, there being almost an entire absence of politics in the administration. The terms of the members of the board have averaged from 6 to 12 years. This has produced a continuity of the general policy of this department.

The first agitation for a municipal lighting plant in Hudson came in 1891, when the town voted to take over the business of the Hudson Electric Light Company. Six years of litigation followed, so that the town did not



Auxiliaries, silencer and heating boiler in rear of No. 4 engine and side view of that engine showing water circulating pumps.

actually begin to sell electricity until January 15, 1897. At that time the power plant consisted of a horizontal return tubular boiler of 150 hp, a 100 hp Ball engine, and a small alternater and street lighting generator, located in the basement of a local shoe factory. The town at once built a new station at the eastern end of the town, where there were ample side track and water privileges, and the generating equipment was moved from the factory to this new station in 1898. The business continued to grow and from time to time until 1918 boilers, engines and turbines were added, until at our entrance in the World War, in 1917, the station consisted of four return tubular boilers, totalling 750 hp, operating at 130 pounds pressure, two engines driving generators, and a 200 kw and a 600 kw General Electric turbine, totalling 1200 kw. The engines and turbines were operating condensing.

With the increase in business at the close of the World War, a 1000 kw connection was made with an outside transmission company, and the station operated parallel with the transmission company until 1928. By 1926 it was seen that the boilers and engines were fast deteriorating, and that a definite method of power generation would have to be decided upon. Four schemes were carefully investigated:

1. Purchasing all power from the transmission company.
2. Building a new steam station to operate at high pressure and superheat.
3. A combination of 1 and 2.
4. A Diesel engine station.

At the conclusion of a year and a half's investigation, the Diesel proposition seemed to be the best in our particular case as the town was unable to obtain what was believed to be a fair contract from the transmission company.* In April, 1928, a contract was entered into for two 900 hp and one 675 hp Diesel engines direct connected to 2300 volt, 60 cycle generators, and a portion of the station building was remodelled to receive these engines. Our connection with the transmission company was of sufficient capacity so that we could buy all our requirements from them during these alterations. All the old equipment was removed, and one-half the engine room roof was raised 11 feet to provide ample headroom for a 10-ton travelling crane. The Diesel engines were started January 1, 1929. Our connection with the transmission company was severed on July 1, of the same year. The station has since operated as a wholly independent station.

Immediately a great reduction in expenses was experienced, so much so, that rates were materially reduced during the next two years, and in spite of the depression which seemed to grip the rest of the country, the business, particularly in the domestic field, increased very rapidly. This was due to the promotional rates offered customers, and to ample advertising in our local paper.

These changes were financed by a bond issue of $40,000 payable annually in equal installments of $4000 over a period of ten years, plus $127,000 surplus that the department had accumulated during the previous six years. In spite of our low rates we found that we were accumulating a surplus quite rapidly, so that in 1932 we were able to turn $35,000 into the general treasury of the town for tax reduction, and still had about $85,000 surplus left. Our business had increased so, and commodity prices were so low, that it seemed wise to install another engine. This was voted in August, 1932, the work starting immediately. The station building was entirely modernized, and the new engine, of 1200 hp, installed and started on February 1, 1933. Since that time we have again started to accumulate a small surplus each year, so that on July 1, 1934, we announced another reduction in rates, a schedule of which is herewith appended, which we believe are among the lowest rates in New England.

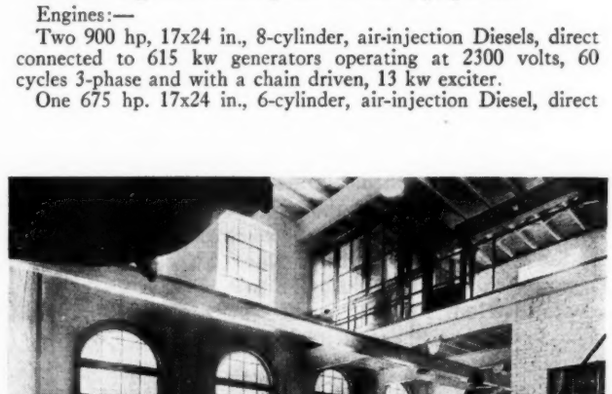
The output has increased 162% in ten years with only 12% increase in expenses, and the amount of electricity given the average customer for $1.00 has increased 2 1/3 times.

Following is a description of the equipment:

Engines:—

Two 900 hp, 17x24 in., 8-cylinder, air-injection Diesels, direct connected to 615 kw generators operating at 2300 volts, 60 cycles 3-phase and with a chain driven, 13 kw exciter.

One 675 hp. 17x24 in., 6-cylinder, air-injection Diesel, direct



Street lighting equipment, feeder voltage regulators and synchronous condensers.

*The best price received from the power company was about 1.25 cents per kwhr, while we found we could generate our requirements for about 9 mills per kwhr.

connected to a 460 kw generator and with a chain driven exciter.

One 1200 hp, 20x24 in., 6-cylinder mechanical injection Diesel, direct connected to an 835 kw generator and chain-driven 15 kw exciter.

Engine manufacturer: McIntosh and Seymour Corp.
Generator manufacturer: General Electric Co.
Switchboard and instruments: General Electric Co.
Motor generator exciter: General Electric Co.
Fuel oil: Cities Service Co. Navy "A" Standard.
Lubricating oil: Texas Co.
Silencers: Maxim.
Governors: Massey on 1200 hp engine; McIntosh and Seymour on others.
Exhaust pyrometers: Bristol Co.
Centrifuges: Two No. 360 De Laval Separator Co.
Oil transfer pumps: Viking and Perfection.
Emergency air compressor: Worthington 4¼x1½x5 in. compound direct connected to Novo gasoline engine and 5 hp Wagner motor.
Traveling crane: New Jersey Foundry and Machine Co.
Raw water pumps, two 6 in. Lawrence Machine & Pump Co.
Jacket water pump, one 5 in. and one 4 in. Lawrence.
Emergency make-up valve: Golden-Anderson.

The fuel oil originally used was a 24°-28° gravity oil costing us about 5.1 cents per gallon delivered. After a year's use of this, we changed to a Navy "A" Standard oil of about 18°-20° gravity to effect a saving in price. This oil has dropped as low as 2.9 cents per gallon delivered, but due to the Code is now costing about 4.37 cents per gallon.

Electricity is generated and distributed at 2300 volts, 60 cycle, 3-phase, all of the system being overhead except in the business district, where a "White Way" system of street lighting is supplied through underground conduits. Electricity for domestic use and commercial lighting is supplied to the customer at 110-220 volts, 3-wire, single phase, and for power customers at 550-2300 volts, 3-wire, 3-phase.

On January 1, 1934, there were 2567 domestic customers, 386 commercial lighting customers, and 197 commercial power customers. The domestic use of electricity was 1,434,656 kwh, commercial lighting use was 582,965 kwh, and the commercial power use of electricity was 1,528,155 kwh.. For street lighting, 322,620 kwh was distributed for the following street lights: Forty-two 1000 candlepower ornamental; five 2000 c.p. multiple lamps in the large square in the center of the town; fifty-five 100 c.p. bracket lamps, and five hundred and eighty-one 60 c.p. bracket type lamps. A copy of the rates follows herewith:

Rate Schedule

Domestic; Rate A

1st 20 kwhrs. per month at 5 cts. net
next 80 kwhrs. per month at 3 cts. net
next 100 kwhrs. per month at 2 cts. net
over 200 kwhrs. per month at 1 ct. net

Commercial Lighting; Rate B

1st 40 hours use of demand at 5 cts. net
next 150 hours use of demand at 3 cts. net
next 150 hours use of demand at 2 cts. net
over 340 hours use of demand at 1 ct. net

Commercial Power; Rate C

1st 100 kwhrs. per month at 4.0 cts. net
next 1200 kwhrs. per month at 3.0 cts. net
next 4700 kwhrs. per month at 2.25 cts. net
next 10000 kwhrs. per month at 1.8 cts. net
next 34000 kwhrs. per month at 1.5 cts. net
over 50000 kwhrs. per month at 1.25 cts. net

Wholesale; Rate D

1st 50 hours use of demand at 2.5 cts. net
next 50 hours use of demand at 2.0 cts. net
next 75 hours use of demand at 1.5 cts. net
next 75 hours use of demand at 1.0 cts. net
over 250 hours use of demand at .8 cts. net

Primary; Rate E

1st 30 hours use of demand at 2.5 cts. net
next 30 hours use of demand at 2.0 cts. net
next 30 hours use of demand at 1.5 cts. net
next 30 hours use of demand at 1.0 cts. net
over 120 hours use of demand at .7 cts. net

Commercial Water and Air Heating; Rate F

1.25 cents net for all electricity

Rate A applies to residence lighting, cooking, water heating, refrigeration, oil burners and all non-commercial appliances used in a single private dwelling; also to commercial installations where the total connected load does not exceed 1,000 watts. Rate B applies to all types of commercial lighting; until demand meters are installed, the demand will be reckoned as 75% of the connected load of lights and appliances used. In Rate C, the kwh used for lighting on premises served by a power meter are charged at the power rate where they exceed, during any one year, 15% of the total kwh used on such premises. Rate D is available to customers who control other available sources of power which they can use to avoid a system peak. Rate E is primarily for refrigeration plants whose capacity factor averages at least 40% during any month and which purchase current at 2300 volts. Rate F is available for all types of commercial water and space heating except commercial cooking.

Following is an abbreviated financial statement from the report for the year ending December 31, 1933:

Hudson Light and Power Department Costs for 1933

Production Expenses		*Per kwhr. generated, mills*	*Per kwhr. sent out, mills*
Superintendence and labor	$14,846.61	2.87	3.27
Fuel	14,929.91	2.93	3.29
Water	269.18	0.05	0.06
Lubricants	1,844.17	0.36	0.41
Maintenance:			
Station structures	1,709.38	0.33	0.37
Diesel plant equipment	523.89	0.11	0.12
Accessory electric equipment	45.27	0	0
Diesel engines	1,132.49	0.22	0.25
Total	$35,300.90	6.87	7.77
Distribution expenses	11,953.11	2.3	2.63
Utilization expenses	1,542.60	0.3	0.34
New Business expenses	1,511.59	0.29	0.33
General expenses	31,250.28	6.1	6.88
Total operating expenses	$81,558.48	15.87	17.95
Overhead costs chargeable to production			
Depreciation	$ 5,000.00	0.97	1.10
Interest on bonds	1,800.00	0.35	0.4
Bond repayments	7,500.00	1.46	1.65
Insurance on production equipment and additional men	500.00	0.09	0.11
Overhead expenses	$14,800.00	2.87	3.26
Total overhead and operating costs chargeable to production	$50,100.90	9.74	11.03

In conclusion, the experience of the town of Hudson with this municipal lighting plant has been very successful. The rates have been extremely low, and the service good. The plant has been self-supporting in all its departments since about 1915. Previous to that time the town used to advance small amounts each year to make up deficits, but these were all paid back by the $35,000 given the town from earnings in 1932, so that the plant has cost the town nothing to date. The real advantages of a Diesel generating station over purchased power, or in Hudson's particular case, over a steam station, has been that the town is able to maintain very low operating costs and in particular to be in a position to sell electricity off-peak for very low rates. and their ability to offer the long-hour user of electricity very low average rates.

Planting adds to attractiveness of Hudson's Cherry St. Station.

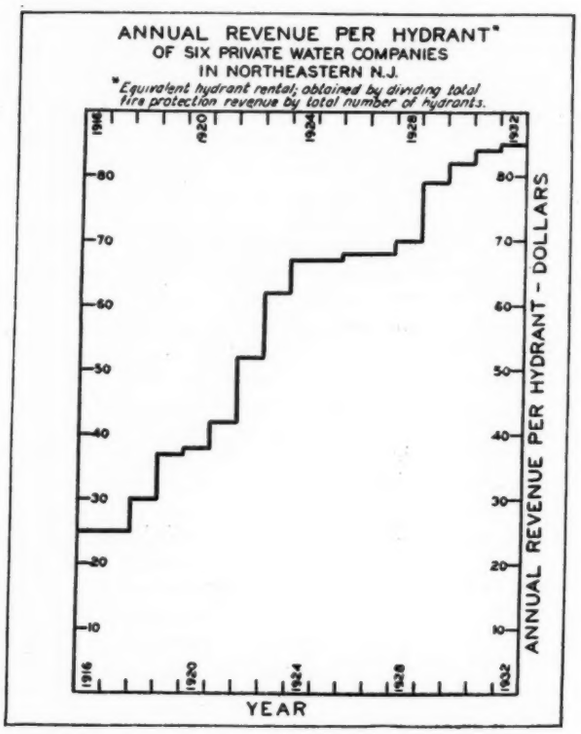
Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

ELEVATED tank control may be necessary, to save the water stored therein for peak demands, where the tank capacity is reasonably close to the minimum requirements. "At Milwaukee, two elevated tanks are controlled through a clock mechanism which opens the tank valve during the filling period, then closes it. It remains closed until a certain hour in the afternoon when the valve is automatically opened allowing the contents of the tank to feed the deficient area surrounding it. At Louisville, Ky., a 30 m.g. elevated reservoir is controlled by an electric valve operated through telephone wires from the pumping station 15 miles away."[A10-3]

Peak consumption is being increased by the short working day. "The laboring man now keeps banker's hours. This has resulted in hourly peaks of use nearly double the rates that prevailed fifteen or twenty years ago," since the meals and other uses of water by all classes come at the same time. Careful studies of consumption in four cities in as many different states, of 43,000 population to 330,000, showed maximum peak consumptions (hourly rates) of 260 to 350% the average. The excess in per capita gpd rates ranged from 216 to 280, and "this variation seems to have very little connection with whether the water is metered, or the average consumption per capita. The excessive demands apparently represent uses and have little to do with waste. Peak uses may vary in different towns, but the variation is less than might be expected. These data indicate that adding 250 to 300 gallons per capita to the average use will probably cover the peak hour requirements under ordinary conditions." There are, of course, exceptions. Denver, Colo., for example, has reached a peak of more than 700 gal. per capita over the average. This excess consumption is of short duration, and in an ordinary case a reservoir capacity of two-thirds the maximum-day consumption will suffice to equalize the pumpage throughout the day; to which should be added the requirements for fire protection.[A10-3]

Tastes and odors in Chester, Pa., water due to industrial and oil refinery wastes, sewage and numerous other causes have been combatted by use of "every known method of treatment." Those finally selected for use were bleaching clay, nozzle aeration, and ammonia-chlorine. Bleaching clay removes tastes and odors due to oil, gives a stronger and more adsorptive floc, tends to stabilize the sludge. Aeration removes most of the odor due to the more volatile oils and entrapped gases. Prechlorination with contact oxidizes odors due to organic matter and tends to condition the water for coagulation. In a recent test, aeration alone reduced the odor from 200 to 100, and prechlorination reduced this to 8. [A7-21]



Hydrant revenues of six New Jersey companies

Fire protection charges by private companies in New Jersey is largely on the inch-foot basis plus $10 per hydrant annual service charge. Revenue of the six largest water companies in north-eastern New Jersey, supplying nearly 50% of all the water used in that district, divided by the number of hydrants as a convenient unit of comparison, has increased from $25 in 1916 to $85 in 1932; the minimum revenue in the latter year being $25 and the maximum $122. The rapid change during 1917 to 1924 was because all the companies were instituting rate cases before the Public Utility Commissioners for the purpose of obtaining revenue on the inch-foot basis. In 1932 the fire protection revenue was 16% of the gross revenue, $1.12 per capita, $550 per mile of distribution mains, or $1.00 per inch-foot.

If municipal water departments received such revenue from their municipal governments, it would permit them to cancel most existing deficits and produce profits; and would permit them to build a great deal of much-

needed extension and reinforcing of distribution systems, resulting in improved facilities and service, reduced insurance rates and a large amount of local employment.[G10-6]

Wrecking elevated tanks by throwing them from their foundations and then cutting them up on the ground was found much less expensive than taking them down piece by piece, and much more rapid, in the case of two tanks of the Washington Suburban Sanitary District. The lowest bid for taking them down piece by piece and disposing of the steel was $990; the actual cost of the former method was $150. Referring to the drawing, a section 8 ft. long was cut from leg A near the ground, then the foundation bolts on the other three legs were cut. A 6 x 6 timber placed through the cross members of leg C was raised by two 10-ton jacks, the tank falling when it had risen 12 in. This was done in one hour at each tank. A third tank could not be thrown down because of neighboring houses. A similar method employed for a much smaller tank at Luke, Md., cost only $14.80, and the tank as it lay was sold as junk for $52—$4.00 a ton.[HH10-8]

Mains freeze more generally in February than earlier because heat passes through ice 6 to 16 times as rapidly as through dry soil and 2 or 3 times as rapidly as through wet soil; therefore heat below keeps mains from freezing until the ground freezes slowly down to them. The depth of penetration of frost is controlled largely by the total temperature deficiency (below 32°) to date and the snow blanket. Pipes in a 5-ft. trench may freeze with 600° deficiency with practically no snow blanket, or resist 1100° with sufficient snow blanket. Apparently 8″ additional snow blanket increases by 450° the deficiency needed to freeze mains. "To get the frost line in inches below the surface, divide the deficiency in degrees by the average snow blanket (for the two weeks preceding) in inches plus 4." This does not hold good after March first.[EE9-1]

Inserting gate valves in mains under pressure in Evansville, Ind., by the A. P. Smith Co. in 1933 cost for 35 valves 6″ to 30″, $2,233.88 for labor; $460 for lead, manhole covers, etc.; and $672 for repair of streets; while the valves themselves cost $16,476. The average time for inserting the two 30″ valves was about 16 working hours; the 24″ and two 20″ about 8 to 10 working hours; not including digging or backfilling. On the fourteen 6″ and five 8″ valves the time was cut down to one, two and three valves per day, with a crew of five men at the machine.[A9-2]

Centrifugal pumps with double suction are preferable to single suction for all but very small units and all 2-stage pumps above 3″ should be tandem. Motors should be of the full-voltage starting type, and preferably induction rather than synchronous except for large units; synchronous motors being more subject to a number of diseases. The check valve should give a full, clear opening equal in area to its nominal size; should be ruggedly constructed and capable of closing as nearly instantaneously as possible. Some makes of swing check valves are usually suitable for all but large installations, for which more elaborate valves are often necessary. Foot valves are objectionable because of their high head losses and the danger of bursting pump casings if the discharge check should fail to close; for the ordinary plant the water ejector furnishes the best and simplest means of priming if pressure water will always be available, otherwise a rotary vacuum pump is suitable.[A7-14]

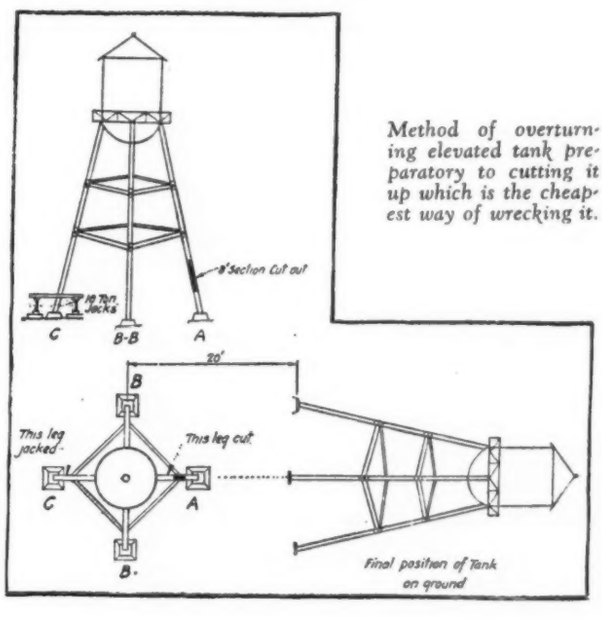
Concrete was pumped 1,000 ft. through a 7 in. pipe for Dam No. 5, across the Mississippi river, using a reciprocating piston pump. The concrete had a slump of only 1½ in. Temperature during pumping fell to 10° below zero. Vibrators were used on the concrete and a good result obtained.[L9-3]

Typhoid mortality in 1933 for 93 cities, as reported by the Am. Medical Ass'n was the lowest ever registered. "The typhoid mortality rate in American cities of more than 100,000 population is now less than half what it was only seven years ago. . . . Sixteen of the 93 cities had no typhoid deaths at all in 1933, the largest number of cities yet reported with a perfect score." However, there were slight increases in rates for the cities of the So. Atlantic, West No. Central and West So. Central states. No city registered a typhoid mortality rate greater than 10 per 100,000 and only seven registered as high as 5. Of the latter, all of which are southern cities, New Orleans leads with 9.1, of which it claims that one-third or more were non-residents. "Analysis of the typhoid death rates in several southern states have shown that in many localities the white typhoid mortality is as high as the typhoid mortality among negroes, and in some localities even higher."[A9-12]

Hydrated lime is generally more satisfactory and economical than quicklime where not more than 500 lb. per day is used; for larger amounts, quicklime will generally be more economical, costing about ¾ as much. Three tons of quicklime has the chemical value of 4 tons of hydrated lime and costs about the same per ton. Lime slaking should always be carried on at a temperature between 175° and 200° F.[A7-19]

Orthotolidine deteriorates when exposed to sunlight for a few weeks. The same is true of dichromate-copper-

(Continued on page 49)



Method of overturning elevated tank preparatory to cutting it up which is the cheapest way of wrecking it.

Have You Heard?

Water and Light Commission Aids Virginia, Minn.

When Virginia, Minn., needed $78,600. last fall to tide over a temporary shortage in anticipation of taxes, it was able to borrow that sum from the Water and Light Commission.

According to M. C. Bright, Superintendent, the Water and Light Commission had a cash surplus which was drawing no interest and the above sum was loaned to the city without interest and was fully paid in two installments on June 1st and November 1st in 1933. The City could undoubtedly have borrowed the sum elsewhere, from the local banks for instance, who have from time to time advanced money to take care of emergency salaries, etc. However, the bank would charge interest and it was good policy on the part of both the Water and Light Commission and the City officials to handle the loan in the above manner, thereby saving the interest which would otherwise have been charged.

No similar application for loan on the part of the city officials has been made in 1934. There is no present indication that they will apply for a loan.

The Water and Light Department deposits with the City Treasurer all sums over and above net earnings in a water and light fund which is handled by warrants drawn by Water and Light officials. This fund is entirely separate and distinct from the general fund of the City of Virginia and is subject only to disposal by officials of the Water and Light Commission.

Why Struthers' Water Consumption Figures Are Low

Struthers, Ohio, together with Poland, which have a combined population of 15,000, is served by the Ohio Water Service Co., which reports a per capita consumption of only 33 gallons per day. Even with 100 per cent meterage this is a low figure. This is explained by the fact that this supply is furnished for domestic consumption only; the same company furnishing an entirely separate supply for the industries of these communities and of all others in the Mahoning Valley. This industrial territory contains about 250,000 population and the industries use 10 mgd., or an average of 40 gal. per capita. This would seem to give Struthers a total consumption of 73 gal. per capita.

The domestic supply is treated chemically. The amounts used for a consumption of 180,000,000 gallons during the year are approximately: Liquid chlorine, 500 lbs; ammonia, 300 lbs.; activated carbon, 400 lbs.; copper sulphate, 200 lbs.

Boise Has Hot and Cold Water Services

Boise, Idaho, has a dual water supply, which is unusual but one of the supplies is hot water, taken hot from wells, which is *most* unusual. The hot water is derived from two 16-inch wells, from which it is raised by 10-inch electrically driven deep-well turbine pumps 160 ft. below the surface. This supply has been in operation for nearly forty years, and has shown no sign of failure in either temperature (which is about 170° Fahr.) or quantity.

More than 1,000,000 gallons per day of this hot water is delivered by the water company and is used for bathing, heating and other domestic purposes. The water has a high mineral content, which has introduced some difficulties which the company have been able to overcome but one due to its heat has not been solved satisfactorily—metering the domestic supplies. Said the manager: "Hot water meters have been tried with unsatisfactory results, and cannot be depended upon, because of their being greatly influenced by temperature changes. At present, consumers are charged for combined heating and domestic service based on the size of a waste opening in a disk or nipple installed at the end of the return line on the heating system, from which the water is discharged into the sewer. The connections for domestic service are made on the heating supply line. The absence of measuring devices frequently works a hardship on the company in furnishing good service during extremely cold weather," as many consumers let their domestic fixtures run continuously with the erroneous idea that this will bring more heat into the heating fixtures.

Westinghouse Introduces a New Range for Mass Market

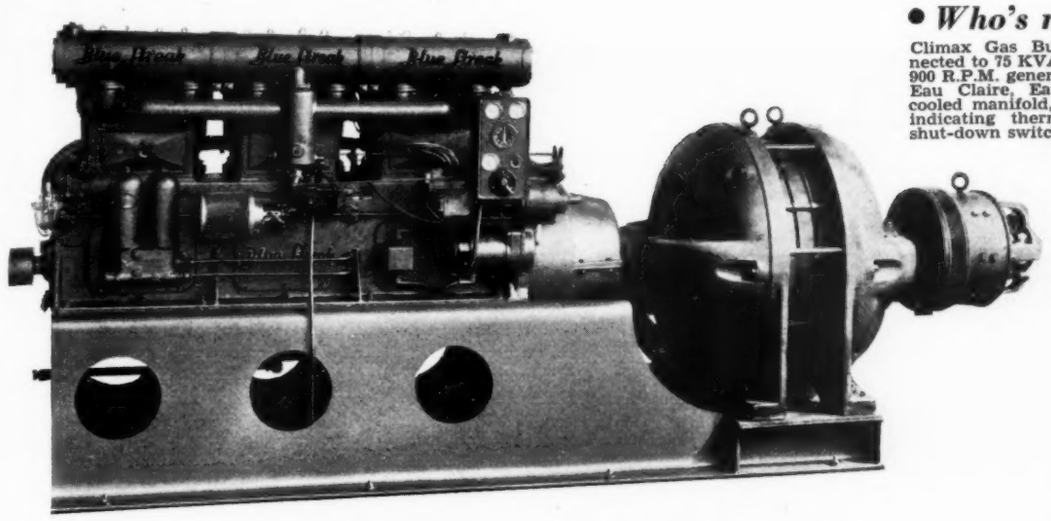
Designed for mass production, Westinghouse's new Cardinal range sells for $61.25, less than half of previous models. The heating units, thermostats and switches are the same as in the most expensive models. Other noteworthy features include welded construction throughout, new Du-lux finish put on at 350°F., Sanalloy finish on unlacquered parts, standard insulation of 1½ inches of rock wool.

With the first real bid for sales in the low income bracket, Westinghouse expects a minimum sales of 175 ranges a day in a potential 6 million market. There are 8 million wired homes in areas with favorable rates with only 1,200,000 electric ranges installed. Where 3c electricity is available, it is stated that cooking for a family of four on this range will cost $3.60 a month.

There are two 6 inch 1,000 watt and one 8 inch 1,800 watt cooking units. The oven is full size with a 2,000 watt unit and is porcelain lined. The new finish will not chip like enamel.

New Westinghouse Range

• *Who's next?* Photo shows typical R6Z Climax Gas Burning Engine direct connected to 75 KVA, 3 phase 60 cycle, 460 Volt, 900 R.P.M. generator for standby for City of Eau Claire, Eau Claire, Wis. Has water cooled manifold, dual ignition, tachometer, indicating thermometer, and over speed shut-down switch.



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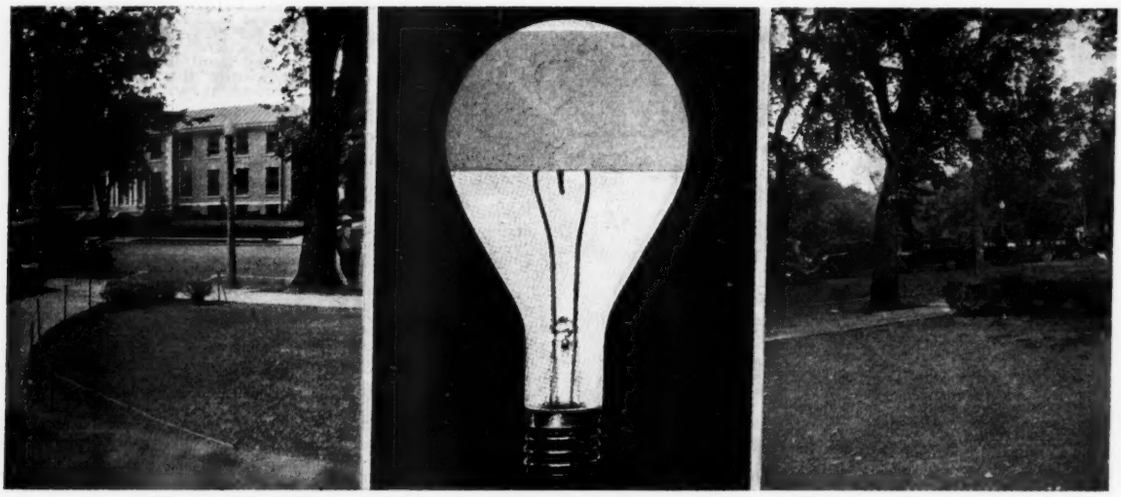


Scenes in Wheaton, Ill., showing ornamental street lamps. Also close-up of coated lamp.

Wheaton Cuts Its Street Lighting Costs

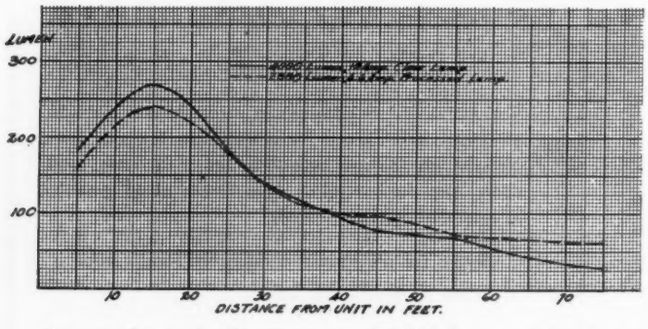
By C. E. Hogeboom
City Clerk, Wheaton, Ill.

WHEATON, Illinois, a city of approximately 7500 population, recently found a way to reduce its electrical bills on ornamental street lighting without reducing either the number of burning hours or the efficiency of lighting.

Prior to 1927, the ornamental street lights consisted of 19 lights, burning a variance of wattages of from 60 watts up to 300 watts. In 1927, a new system of ornamental street lighting was installed consisting of 87 posts installed for 400-candlepower lamps. A transformer with a ratio of 1:1, designed for operation on a 60 cycle alternating current with a rating of 6.6 amperes, was installed adjacent to each post. The secondary sides of these transformers were designed to have taps for one 250-candlepower lamp or one 400-candlepower lamp.

In order to provide sufficient illumination on the streets, it was necessary to burn 4000 lumen, 15 ampere lamps in each post. Forty-three of the 87 lamps burned part of the night and the remaining 44 burned all night. The average electric bill for one year's lighting was between $2200 and $2400.

Recently our city installed, in place of the 4000 lumen, 15 ampere clear lamps, 2500 lumen, 6.6 ampere lamps processed on the outside of the lamp with pure silver. By processing on the exterior of the lamp, it is possible so to control and direct the illumination as to divert to the street the useless rays which have been wasted in the upper zones.



Comparison of effectiveness of 4,000 lumen clear lamp and 2,500 lumen processed lamp.

Recently tests were conducted with an illuminometer to determine the difference in effectiveness between the 4000 lumen, 15 ampere clear lamp and the 2500 lumen, 6.6 ampere processed lamp. The results found at the conclusion of the tests are as follows:

1. A 2500 lumen, 6.6 ampere processed lamp delivered on the street 982.75 lumen, or 1.75% more lumens than the 4000 lumen, 15 ampere clear lamp.

2. A 4000 lumen, 15 ampere clear lamp, using the city's present glassware, was 24.13% effective as a street illuminant.

3. A 2500 lumen, 6.6 ampere processed lamp, using the city's present glassware, is 39.30% effective as a street illuminant.

From the above summary of tests it can be readily seen we are obtaining more effective lighting with a smaller bulb which is processed on the outside, and at the same time we are reducing our electric bill by approximately $1000 per year, or over 40 per cent.

Water Consumption Data by Month at Swampscott, Mass.

All services are metered in Swampscott, Mass., a city of 10,346 population, and the average consumption per capita is slightly under 80 gallons per capita per day. By months, the per capita consumption is given by J. M. Mather, superintendent, as follows. for the year 1933:

January, 60 gallons; February, 60; March, 63; April, 69; May, 76; June, 88; July, 96; August, 97; September, 72; October, 60; November, 54, and December, 56.

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(Continued from page 45)

sulfate standards, although the deterioration is not so rapid. Both standards and reagent should therefore be protected from light when not in use.[A7-20]

Magnesium filters, using magnesium scraps, turnings, etc., are found by Bach to dechlorinate water (but not to remove chlorophenol), to remove free carbonic acid completely, to raise the pH to 8.4, and possibly to act as a bactericide (experiments on the last are being contained). The cost for dechlorinating 10 mgd of water containing 0.5 ppm chlorine residual is estimated at 18 cts per capita per year; decarbonation of 20 ppm of CO_2, $1.80 per capita per year.[G9-3]

How to find the references

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

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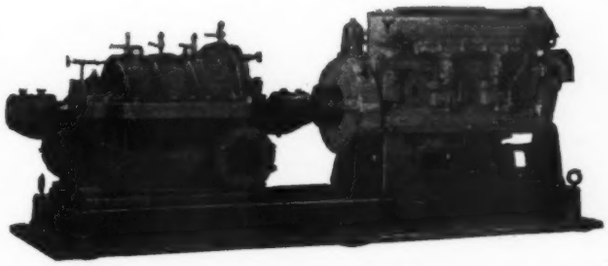

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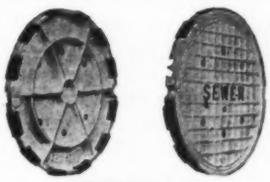

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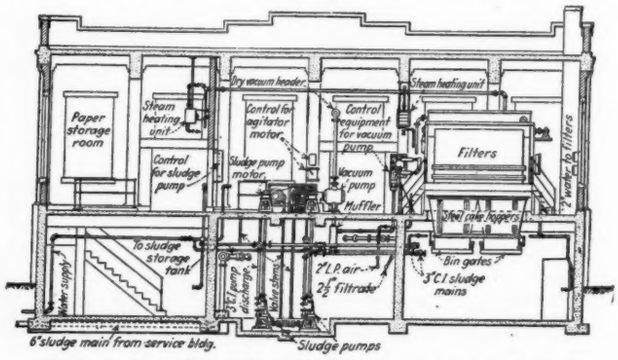
A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

The Digestion Tank

SELLING sludge is greatly facilitated if sludge cake is shredded and fortified with chemical fertilizers. Typical digested sludge contains 2% total nitrogen (0.12% ammonia nitrogen and 0.76% available nitrogen), 0.62% total phosphoric acid and 0.13% total potash; a total of 2.71% plant food constituents, compared to 16% or more in commercial fertilizers. It is a valuable source of soil humus, which must be used when inorganic chemicals are used as fertilizer. To make a ton of well balanced fertilizer, to 1650 lbs. of dried disintegrated sludge add 100 lbs. of ammonium sulphate, 200 lbs. of acid phosphate (20% P_2O_5) and 50 lbs. of muriate of potash, costing $3.85 for the chemicals and perhaps $3.00 for the shredded sludge, and worth much more than manure at $10 to $14 a ton. Most unprepared sludge is difficult to sell because it has a disagreeable odor, is lumpy and difficult to spread, there is aesthetic dislike for the source of the product and lack of appreciation of its value. Mechanical driers are too expensive for small plants. Hand screening may be used for small quantities. For larger amounts, shredding machines are used. Trenton, N. J., uses a Royer Disintegrator—a portable hopper, the bottom of which is a rapidly moving currycomb-like belt set at an angle with the horizontal which throws out the shredded sludge—which handles sludge of 50% moisture or more, at a cost for handling and electric power of 68 cts. per cu. yd.[G10-3]

Mechanical filtration, as compared to standard digestion and sand drying, is not economical for plants serving less than 50,000 persons. Cost of mechanical filtration of digested sludge is higher than that of operating sludge drying beds, although for large plants or favorable chemical costs the reverse may be true. Mechanical filtration of raw sludge may cost less than combined digestion and sand drying in plants serving 100,000 persons or more, but disposing of crude sludge cake may involve additional expense. The above conclusions are based on data from Illinois plants, but the costs of operating mechanical filtration plants are largely estimates. "Further study and experimentation on mechanical dewatering may result in lower costs but on the other hand there seems some possibility, with further study, that the net cost of digestion and sand drying may also be further reduced." No credit is given for gas produced or sludge sold. The cost at six Illinois plants of sludge digestion and sand drying, per ton of dry raw solids, varied from $7.15 to $21.50, including both fixed and operating charges, the former being $4.65 in the first case and $15.01 in the last. Treating raw sludge by mechanical filtration is estimated to cost from $8.90 (for 200,000 population) to $39.30 (for 10,000 population), the fixed charges being 41% to 45% of the total.[G10-1 & 2]

Vacuum filtering at Hagerstown, Md., began in 1933,[G6-1] using two filters manufactured by Filtration Engineers, Inc. A mixture of fine screenings, sludge from preliminary settling tanks and activated sludge is thoroughly mixed with a mechanical agitator, and averaged 3% dry solids. During 1933 it was dosed with quicklime to give a stable cake, mixed with paper pulp suspension (about 3% paper solids) and vacuum filtered. Paper cost $8 a ton, and shredding was a formidable task, and both filtrate and cake were unsatisfactory. Changes were made in January, 1934; lime and paper pulp were discontinued; ferric chloride was mixed with the sludge, then lime, immediately before filtration. Since then all solids (4,000 dry lb. per day) have been handled comfortably in a single shift without the use of paper pulp, and cake thickness increased from 0.1 in. to 0.25 in. There is no odor connected with the



Section through building of Hagerstown treatment plant. There are two concrete storage tanks (not shown) in the basement of the building, one for sludge and one for pulped paper.

filter operation except free ammonia and the cake, spread on land, develops no odors. Cost of vacuum filters, auxiliary equipment, pumps, etc., $34,000. Cost of filtering, chemicals, power, etc. $13.74 per ton of dry solids filtered, or $9.70 per million gallons of sewage treated. Average sewage flow, 2.33 mgd. Connected population, 28,000. Power used per ton of dry solids, 43 kwh. Ferric chloride used, 5.5% of dry sewage solids; lime, 9.4%; cost of both, $7.25 per ton of dry solids filtered (purchased in small lots). Referring to *use of paper pulp,* the author says: "A sludge impossible to filter otherwise may be made filterable by the addition of sufficient paper pulp, diatomaceous earth or other porous filler. It is possible that in those communities where paper is collected by the municipality at a cost little above that of hauling paper to a municipal incinerator, paper pulp may be advantageously employed for sludge filtration."

The Dearborn, Mich., plant had been in service for two years on May 1, 1934, and a summary of the operating experience of that period has been given by the superintendent, Mark B. Owen. Except for the last 6 months the chemical-mechanical plant, the west side plant, handled an average of 1.6 mgd of sewage mixed with 236,000 gal. of sludge pumped from the east side plant. Therefore figures are difficult to interpret except for those 6 months. Also, changes were made to both plant and procedure during the first year.

During the last half-year the suspended solids were reduced from 230 ppm to 19 in the effluent—92% red.; the 5-day B. O. D. from 128 to 28—78% red; chemicals used for sewage coagulation, 147 lb. of calcium oxide per mg, 306 lb. of ferric chloride and 73 lb. of paper. (During the first half-year these quantities were 1133 lb., 336 lb. and 358 lb. respectively for mixed sew-

age and sludge.) The sludge cake produced totaled 6,963,700 lb. of 67.2% moisture, the vacuum filter producing cake containing 7.5 lb. of dry solids per sq. ft. per hour. No effort was made to produce a dry cake as it was used for fill on waste land. At intervals of several days filtrate from the filtering of sludges of both plants was run into the west side sewage, increasing the B. O. D. If these days be omitted, the B. O. D. averaged 130 in the influent and 20 in the effluent, with 85% red. During the last half-year the filters produced almost twice as much sludge as during the first half-year, due chiefly to use of ferric chloride and lime instead of lime alone. During the last half-year the cost figures were: Salaries, $13,700; wages, $7,761; electricity, $4,775; chemicals, $7,087; fuel and gas, $3,461; supplies, $662; maintenance, oil, telephone and miscellaneous bringing the total to $38,944. During this time the plant had treated 1.74 mgd of sewage and 0.02 mgd of east side sludge. The cost of the west side plant was $478,853.[C9-6]

Elutriation of sludge was developed and is being studied at the Baltimore sewage works. It was found that digested sludges require more coagulant per unit of dry substance for economic coagulation than do raw sludges. Studies made seem to demonstrate that resistance of sludges to coagulation with relatively small amounts of coagulants is due largely to the soluble decomposition products generated in various sludges and accumulated in the liquid surrounding the sludge particles. This liquid, during biological processes of decomposition, becomes relatively rich in ammoniacal compounds, some of which are absorbed by the colloids and capillary active surfaces or by the active hydrogen ions of such colloids and surfaces. These ammoniacal compounds react chemically with ferric coagulants intended for flocculating the colloids, thus necessitating more coagulant than is necessary for flocculation of the colloids alone. The simplest method of decreasing the concentration of the soluble decomposition compounds consists in diluting the sludge with relatively pure water, or water containing active chemicals or exchange adsorbents, then allowing the sludge to settle and decanting the supernatant equilibrium liquid. This procedure is termed "elutriation" by Mr. Genter. It permits definite saving in coagulant; the saving effected by elutriation of sludge containing soluble ammoniacal products being approximately in direct proportion to the amount of the soluble ammonia-amino compounds removed by elutriation. "A 2:1 elutriation of Baltimore digested sludges will remove at least 60% of the soluble ammoniacal products from the liquor surrounding such sludges and save about 60% of the ferric chloride necessary to produce a floc that can be dewatered in two or three minutes on a suction filter."[C9-3]

Flocculation of sewage improved sedimentation of Halifax (England) sewage.[D8-2] "It was found that marked improvement in precipitation could be effected by gently stirring the acidified liquid (adjusted to a pH of 3.0 or just under) for a period before settlement. In this way larger and more rapidly settling flocs are built up." Seven minutes stirring seemed to be the optimum, giving 78 p.p.m. more solid matter in 2 hrs. settlement than without stirring. "Greatly improved results are obtained by applying the principle to other methods of precipitation, and even flocculant domestic sewage to which no precipitants are added can be made to show a marked improvement in sedimentation rate. Better settlement of activated sludge and of humus has also been obtained on a laboratory scale by gentle stirring for a period before settlement. Filter effluents are

Use PFT Equipment *for* Sewage, Water *and* Industrial Waste Treatment

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Designers & Manufacturers of Sewerage and Sewage Treatment Equipment
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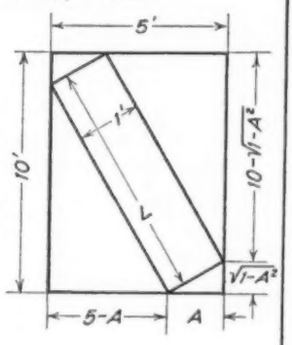
EXCLUSIVELY SINCE 1893
441 LEXINGTON AVE. NEW YORK, N. Y.

SLUDGE BED Glass Overs
For Sewage Disposal Plants
Lord & Burnham Co.
IRVINGTON, N. Y.

THE HALL ROOM PARTY'S PLANK

See "Timewasters," Sep't. 1934

SOLUTION



The largest plank that will fit must just touch all four walls, leaving similar triangular areas of uncovered floor.

Hence

$$\frac{A}{\sqrt{1-A^2}} = \frac{10-\sqrt{1-A^2}}{5-A}$$

After a few trials:

A	$=0.92048$
$5-A$	$=4.07952$
A^2	$=0.8472834304$
$1-A^2$	$=0.1527165696$
$\sqrt{1-A^2}$	$=0.39079$
$10-\sqrt{1-A^2}$	$=9.60921$
$\frac{A}{\sqrt{1-A^2}}$	$=2.3554$
$\frac{10-\sqrt{1-A^2}}{5-A}$	$=2.3555$

Close enough!

$$L = \sqrt{(5-A)^2+(10-\sqrt{1-A^2})^2}$$

$$L = \sqrt{108.97794002545}$$

$$L = 10.439 \text{ feet}$$

BE

Spiral Welded Pipe for Water Supply

MARYSVILLE, county seat of Marshall county, Kansas, with a population of 4,000, is furnished with water by a privately owned plant which takes its supply from the Blue river. Recently, due to a change of alignment of U. S. highways Nos. 36 and 77, it was necessary to change the channel of the river, the new channel being 1,200 feet from the intake in the old channel. This necessitated building a new intake in the new channel and connecting it to the existing purification plant.

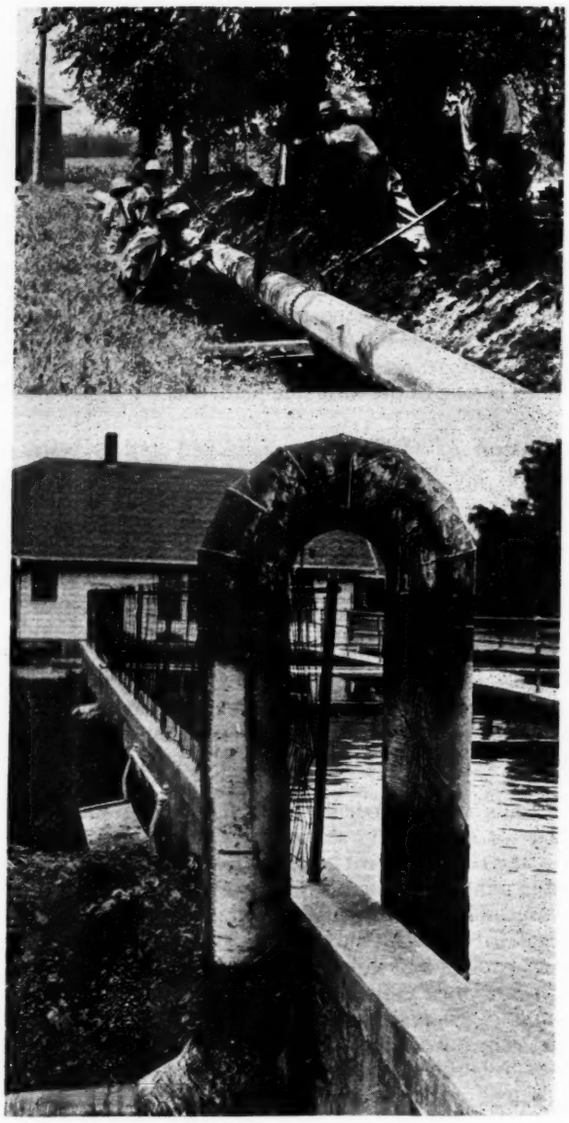
Water taken from the river is pumped under low pressure to a filtration plant located on land above high water; and the filtered water is pumped to the supply lines and a standpipe. Changing the location of the intake and making other changes required the laying of 2,400 ft. of 12", 60 ft. of 8" and 60 ft. of 6" pipe, the contract for which was let locally.

The company used Armco ingot iron spiral welded pipe, asphalt coated, with long-radius els of the same material and five cast steel welding flanges. The 12" pipe was in 40-ft. lengths and the 6" and 8" in 25-ft. lengths, which were connected by welding. All were of 12-gauge iron.

The pipe trench was dug through 1,800 ft. of river silt; 700 ft. of black gumbo, cinders, etc., and a 100-ft. crossing of the old river channel. The crossing was made by the "X" bridging method, which allows silt to build up around the pipe. The pipe was unloaded from the cars and distributed, with an average haul of 1½ miles, by four men using a 2-ton truck in 7 hours. Including two welders working 20 hours each, the total labor of installing the pipe was 1,059 man-hours; and the total cost (not including materials) was $623. Common labor received 30 cts. to 45 cts. an hour.

There was no difficulty in handling the 40-ft. lengths of pipe, and there was of course economy in reducing the number of joints to a minimum. This also minimized any loss of head due to joints; but such loss was slight and the entire interior of the pipe is smooth.

This water works is owned by the Kansas Power and Light Co., which serves about 300 other cities and communities with about 350,000 total population, which has its principal electrical power plant at Tecumseh, Kans., and other smaller scattered ones.



Special fitting at filtration plant. Above: Welding a joint in 12-inch pipe

(Continued from page 53)

similarly improved." These conclusions of Edmondson and Lumb are based on tests of a two-unit Dorr apparatus installed at the Halifax works.

Gas waste phenol was rapidly and completely oxidized by the activated sludge process, in experiments in England. Phenol was reduced 100% in 8 hours or less; catechol 90% in 12 hrs., or in 6 hrs. when the sludge was accustomed to it; thiosulphate lay between these two. Using sectional filters, the first section oxidized almost all of the phenol and the greater part of the catechol, but considerably less thiocyanate. The B. O. D. of sewage containing spent liquor was little, if any, greater after treatment than that of the purified sewage alone.[D9-1]

In regulation of the ***activated sludge*** process, "the most important factor is the condition of the sludge itself. . . ."[GG8-10] (1) Settling and sludge index characteristics of activated sludge cannot be at present definitely correlated with the stage of oxidation and the efficiency of purification of activated sludge. (2) The numbers of bacteria on the dry basis increase, the greater the amount of activated sludge in relation to sewage. (3) The numbers of small protozoa decrease and the large protozoa increase, as the amount of activated sludge is increased in relation to sewage. (4) The biochemical oxygen demand on the basis of unit amount of suspended solids decreases as the amount of activated sludge in a mixture increases in relation to sewage and it further decreases in a given mixture as the aeration period increases. (5) Oxygen consumed per unit of suspended solids similarly shows a decreasing ratio as the amount of activated sludge in a mixture increases and decreasing ratio with increasing time of aeration. (6) The percentage ash in the suspended solids increases with increasing amount of activated sludge and increasing periods of aeration. (7) The concentration of nitrates and D.O. does not increase directly with the condition and quantity of sludge."

(Continued on page 58)

New England Water Works Association

The 53rd annual convention of the New England Water Works Association, which was held at Boston, Mass., September 18-21, was well attended and provided a number of interesting papers and discussions. The Tuesday program was given over, during the forenoon to business, and during the afternoon to an interesting discussion of the place that public works occupy in economic stabilization. The speakers included Willard Chevalier, Abel Wolman and Prof. Meriam of Harvard. The same general topic was covered in the Wednesday forenoon session in a symposium on experiences with the PWA and other governmental agencies for public works construction.

Treatment and purification were the topics Wednesday afternoon, with taste and odor and filtration most prominent. Speakers included R. G. Yaxley, James M. Caird, George C. House, Gordon Fair, Robert Spurr Weston and T. R. Camp. Committee reports, superintendents sessions and the superintendents' round table concluded the program on Friday morning.

The program was an excellent one and the sessions were generally fairly well attended. Inclement weather during the early part of the week limited golf practice and other outdoor activities. Exhibits were interesting and varied.

American Road Builders' Association:

The 1935 Convention and Hotel Exhibit of the American Road Builders' Association will be held in Washington, D. C., January 22 to 25.

In selecting Washington as the location for the 1935 Convention and Exhibit it was felt that inasmuch as Federal and State legislation will play such an important part in continuing the highway program in the next few years, that the proceedings of the Convention from the National Capital will have a far reaching effect. This is especially true since Congress and forty or more state legislatures will be in session at the time of the Convention.

Personal Items:

Joseph M. Hatchett has been appointed city engineer of Petersburg, Va., succeeding William D. Cushman, who has resigned to enter private business.

H. J. Cates has been appointed chief of the sanitary department, Atlanta, Ga., succeeding the late John Jentzen.

Walter Kelsey has rejoined the staff of Lord & Burnham, manufacturer of glass enclosures for sludge drying beds and other similar structures. He is located at the Irvington, N. Y., plant of that company and is available for advice and assistance in connection with glass enclosures of all types.

Jack J. Hinman, Jr., former president of the American Water Works Association, and widely known sanitary engineer, has been promoted to the grade of Lieutenant-Colonel, and assigned as Chemical Officer, 34th Division.

D. D. Morey has been appointed New York manager, with offices at 1451 Broadway, N. Y., for D. W. Haering & Co., Inc., manufacturers of H-O-H water treatment and proportioning units.

The Birmingham, Ala., office of the Chicago Pneumatic Tool Co., has been moved to 211 South 20th St. W. S. Lynch is manager.

L. S. Stephens has been elected to succeed D. B. Pierson as president of the Stephens-Adamson Mfg. Co. of Aurora, Ill.

H. S. McPherson has been appointed manager of mechanical sales, U. S. Rubber Products, Inc., for the St. Louis district. W. G. Mueller succeeds Mr. McPherson in charge of mechanical sales in the Boston district.

R. X. Raymond has been appointed manager of the Minneapolis District for the Chain Belt Co., with offices at 808 LaSalle Ave. He succeeds C. A. Gunther, who becomes manager of the Detroit District, with offices at 5169 Martin Ave.

Link-Belt Company announces several new appointments. G. H. Burkholder, formerly of Philadelphia, is appointed Western Sales Manager of the Positive Drive Division, with headquarters at the Company's Dodge Plant in Indianapolis. W. H. Kinkead has been made manager of sales of Link-Belt Speed Reducers, with headquarters in Philadelphia, succeeding Mr. Burkholder. G. L. Gansz succeeds Mr. Kinkead, and will henceforth be responsible for Philadelphia office sales of the Positive Drive Division.

The former Isometer Company has been reorganized as the Isometer Corp., with offices at Elgin, Ill. Manufacturing and sales facilities have been improved. E. F. Eckel is president; V. W. Eckel is secretary; and F. Ralph Fisher is treasurer.

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

The Maintenance Man

Since Adam blamed Eve for the apple
In words too lurid to quote,
There's always been some poor mortal
Who's fated to be the goat,
And the guy in the highway system
Like the dog who is tied to a can,
Is that poor and unsung hero
Entitled "The Maintenance Man."

For he blades his road in the morning
And leaves it a beautiful sight,
But a tractor goes through with a harrow or two—
You should see that road by night!

He cleans out his gutters and shoulders,
Then tears at his graying locks,
For the sheep come through and a thousand or two
Can scatter a million rocks!

He sweats all week with his hot pot,
Patching each hole, and then
The trucks come through with a trailer or two,
And he patches all over again!

He sets the posts for his guard rail
Two feet eight inches deep,
But a driver comes through with a drink or two,
And the guard rail's a kindling heap!

He places a red reflector
At a curve on the broad main line,
And a hunter comes through, takes a pot shot or two,
And that is the end of the sign!

So he patches his pavement
And toils with his blade,
Cleans out his ditches
And builds up his grade,
Replaces his guard rails,
Trims up his trees,
Crawls through his culverts
To clear out the leaves,
Lays dust oil in summer,
Sprays weed oil in spring,
Drives over each mile
Never missing a thing,
In short he does all
That he possibly can,
This poor patient guy
Called the "Maintenance Man;"
But whenever it rains
And the pavement gets slick,
Or the paint stripe fades
When the fog is thick,
Or a tourist gets dust
On his big sedan—
Who gets the blame?
Why, "The Maintenance Man!"

For since Adam blamed Eve for the apple,
And Cain sowed his first wild oat,
There's always been some poor mortal
Who's fated to be the goat,
And the guy in the highway system
Who everyone loves to damn
Is that poor, long-suffering creature
Entitled, "The Maintenance Man;"
And I think when he meets Saint Peter
And looks at the heavenly road,
Where the tractors all have street plates
And the trucks never over-load,
With never a broken guard rail,
No thistle or puncture vine,
No dust to lay, no weeds to spray
And never a shattered sign,
He'll turn to the worthy Peter with,
"Pete, this is surely swell,
"But I've heard of another district,
"We used to call it 'Hell,'
"And the roads are not so much there
"For they're 'paved with good intentions,'
"And I think that would suit me better,
"You see, I forgot to mention—"
"Just stop right there," Saint Pete will say,
"For now that I look at your pan
"I can see why you'd rather go Below—
"You're an old time Maintenance Man!"

—Gladys Craig Potter (Wife of C. A. Potter, Maintenance Superintendent, Marysville, California.)

New Equipment

Automatic pump controller—Road Shaper —Diesel Economy—Portable Floodlights.

Automatic Pump Controller:

The purpose of this controller is to maintain water in an elevated tank or standpipe between maximum and minimum levels. Since pressure at the pump varies directly with the elevation of the liquid in the tank, the pressure type is the simplest kind of controller.

When the pump starts, it must set the liquid in the main in motion. Likewise, when the pump stops, the moving mass of liquid must be stopped. These conditions set up "surges" which are rapid changes in pressure of amounts considerably higher and lower than the stop and start settings of the controller. With an ordinary pressure switch, the pump would start and stop during these periods, hence tend to increase surging.

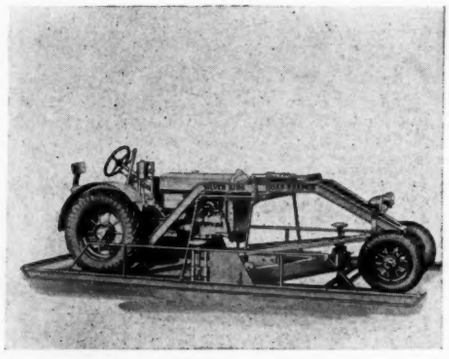
This controller eliminates surging effects on the controller by use of an electrical "snubber" or time delay. This takes the place of the ordinarily used air cushion tank or needle valve, but is not subject to the troubles experienced with such devices.

It is manufactured by the Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

For Smoother Low Cost Roads:

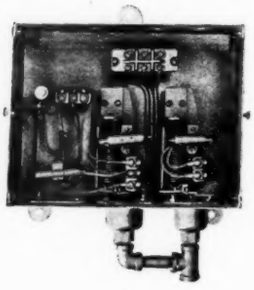
The Silver King road shaper levels road surfaces to a remarkable degree of accuracy and smoothness — dirt, gravel, blacktop or macadam. Designed by E. C. Gledhill, it is powered with a Silver King tractor. Its flexibility, ample power and sturdy construction, makes it an ideal unit for state, county, township and city use.

The four-speed transmission provides variable speeds for all types of road work. The high gear is for transportation or travelling from and to the job, or from one job to another, saving time and labor costs. It is equipped with low pressure tires, rides smoothly, saves fuel and increases speed. This makes cost of operation very low, and combines with low first cost to make the Silver King Shaper a very economical unit to own and use.



The Silver King Road Shaper.

Two blades set at opposing angles, shave off bumps and corrugations, mix and refine the material and deposit it in ruts and depressions. The straight-edges keep the blades running evenly and at uniform depth. The result is a surprisingly level and even surface with complete elimination of "wash board" waves.



The Minneapolis Honeywell pump controller described at the left

The entire weight of the Road Shaper, 1400 lbs. rests on blades, with the straight-edges to keep them running true at the desired depth.

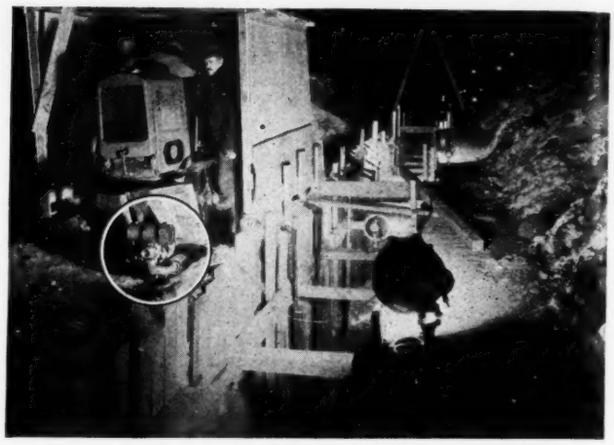
This unit is manufactured by the Fate-Root-Heath Co., Plymouth, O. A descriptive folder will be sent on request.

Fuel Economy With Diesel Compressors:

As graphic evidence of the economy of diesel power, the Gardner-Denver Company is introducing its new diesel portable compressors with a comparative fuel test showing fuel savings.

These new Gardner-Denver portables are powered with the "Caterpillar" diesel engine. In a test for fuel consumption and fuel costs, the Gardner-Denver 360 diesel portable compressor was operated in comparison with a gasoline portable of the same size.

On the basis of full load operation (100 lbs. air pressure) at sea level and with gasoline at 15c a gallon, the fuel cost per hour of the gasoline unit was 94.5c according to Gardner-Denver officials. Under the same conditions, when using diesel fuel at 6.2c per gallon, the fuel cost per hour for the Diesel Portable was only 27.2c—a saving of 67.3c per hour, or a total saving of $5.384 per eight hour day.



On the job—night work with Homelite Floodlight.

New Portable Floodlight System:

The Homelite Corporation of Port Chester, N. Y., announce a new portable 1250 watt generator and floodlights which speed emergency repairs and enable construction to continue after dark. The Homelite generator weighs only 89 pounds complete with its built-in gasoline engine . . . can easily be carried by one man . . . is fully automatic and requires no adjustment whatever The light weight and compactness of this plant enable it to be stowed easily in an automobile or truck.

This floodlighting system is handy and profitable to general building contractors, water departments, highway departments, public utility companies and municipalities for both construction and repair jobs.

Furthermore, in the daytime the Homelite Generator can be used for operating electric saws, drills, hammers, sanders, paint spray guns and other electrically operated equipment. For information, write the Homelite Corporation, 78 Riverdale Ave., Port Chester, N. Y.

Double Seal Connections:

A 24-page catalog has been issued by Hays Mfg. Co., Erie, Pa., on their double seal connections, which provide a means of making joints in copper pipe with a double seal—a 45° and a 90° seat combined. How this is done is told in the catalog which will be sent on request.

Road Maintenance and Construction Equipment:

Littleford Bros, Cincinnati, O., have issued a general catalog covering their road maintenance and construction equipment. It contains only 24 pages, but is very complete and a fine addition to any engineer's library.

Fairbanks-Morse Progress:

"More than a Century of Progress" is the title of a publication by Fairbanks, Morse & Co., tracing the development of their organization and their products. Interesting and with many wood-cut illustrations. Write Fairbanks, Morse & Co., Chicago, Ill.

Booklets

Stone-Tex Restoration Process:

The Truscon Laboratories, Detroit, Mich., have issued a book of interest to those who want waterproof, non-deteriorating structures of concrete and masonry. Copy sent on request.

Water Meters:

Disc meters, frost-proof meters with open and enclosed gear trains, and split case models, also with open and enclosed gear trains are described in Bulletins M-975-B 16, 12, 13, 14 and 15, just issued by the Worthington Gamon Meter Co., Harrison, N. J.

Power Shovels:

A folder describes and gives detailed standard specifications for the new General ½, ⅝ and ¾-yard convertible shovels, draglines, pull-shovels, skimmers, clams or cranes. General Excavator Co., Marion, O.

Arc Welding and Pipe Thawing:

"Simplified Arc-Welding" is a booklet issued by Hobart Bros., Troy, Ohio, which covers the many uses of arc-welding. The equipment listed in this catalog is also available for electrical thawing of frozen water mains. Sent on request.

Sodium Vapor Highway Lighting:

The General Electric Co., Schenectady, N. Y., has issued a folder describing quite fully the G-E Sodium Vapor Lamp.

A New Alkali Plant:

A' brochure descriptive of the new alkali plant of the Columbia Alkali Co., Barberton, O., which will officially open for production this month at Corpus Christi, Tex., is available. Readers will find it interesting and exceedingly well arranged.

Roller Bearings:

A 50-page catalog of roller bearings and self-aligning units has been issued by Shafer Bearing Corp., 6501-99 W. Grand Ave., Chicago, Ill. Applications, specifications, dimensions, uses, service factors and examples. Sent on request.

Diesel Engines:

Diesel engines of the four-cycle type are described in a folder just issued by Worthington Pump and Machinery Corp., Harrison, N. J. These are made in sizes from 50 to 150 hp. 8 pages; illustrated.

Centrifugal Pumps:

Single stage, volute centrifugal pumps in sizes with discharges 1½ to 2½ inches, are described in a 4-page folder issued by Worthington Pump and Machinery Corp., Harrison, N. J.

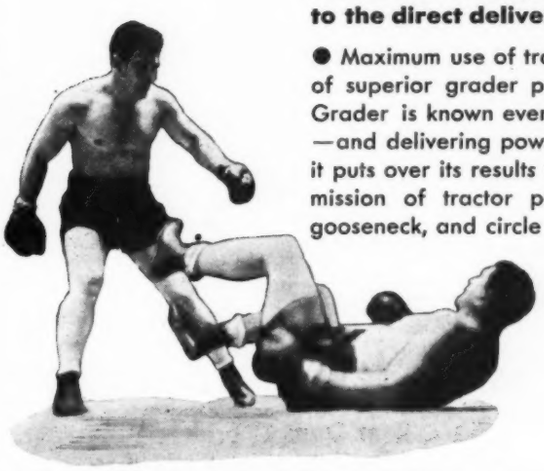
A Heavy Drill:

A folder has been issued by the Chicago Pneumatic Tool Co., 6 East 44th St., New York, describing its new CP-52, heavy sinker drill for heavy sinking in dry or wet holes.

As every muscle in the Champion's body

DELIVERS POWER

...the entire design of this grader contributes to the direct delivery of power to the blade...



● Maximum use of tractor power! The first essential of superior grader performance. The Austin Road Grader is known everywhere for taking punishment —and delivering power. The reasons are many why it puts over its results with a punch, but direct transmission of tractor power through the draw bar, gooseneck, and circle to the blade—is fundamental.

● Hydraulic control available except on No. 8 Grader. If you want to know the factors—massive box frame, control flexibility, etc.—that account for Austin Road Graders leadership, send the coupon below.

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Branches in Principal Cities

Austin-Western

ROAD ROLLERS CRUSHING & SCREENING PLANTS SCARIFIERS MOTOR GRADERS
SWEEPERS & SPRINKLERS ROAD GRADERS ELEVATING GRADERS DRAGS
WAGONS SNOW PLOWS

The Austin-Western Road Machinery Co.
A-5 Aurora, Ill.
Send me complete information on the new 8'□, 10'□, 11'□, or 12'□ Austin Grader
Name .....
Address ..... State .....
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Material Prices

(Published for information only.)

(September 20, 1934)

Warehouse Prices on Reinforcing Steel and Structural Shapes

	Structural Shapes	*New Billet Reinforcing Bars*
New York	3.37c	—
Boston	3.52	—
St. Louis	3.44	—
Cincinnati	3.40	3.25
Pittsburgh	3.15	2.90
Chicago	3.20	—
Philadelphia	2.95	2.955
Cleveland	3.31	2.10*
San Francisco	3.55	3.50

**Plus extras*

Prices on cast iron pipe, net per ton, Class B, 6-inch and larger, AWWA specifications*

Boston	$47.50	Baltimore	$45.50
New York	44.90	Atlanta	42.00
Chicago	46.00	Birmingham	38.00
Minneapolis	48.50	Kansas City	48.15

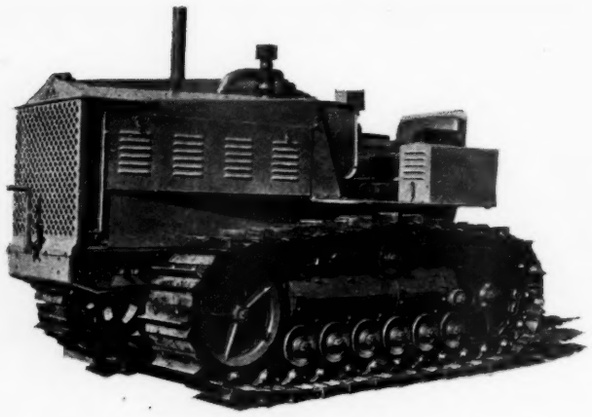
Burlington, N. J., $42.00; extra price for 4-inch, $3.00 per ton; extra for Class A, $3.00 per ton.

**Information, courtesy U. S. Pipe & Foundry Co.*

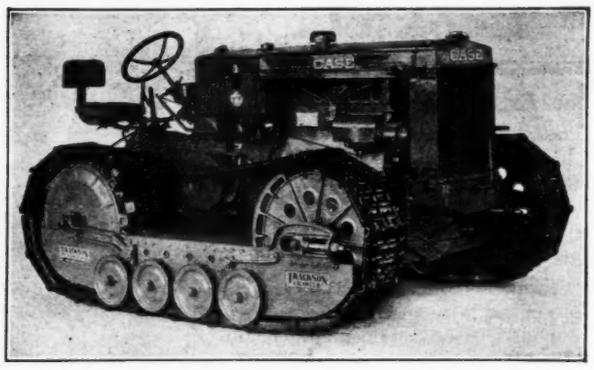
Warehouse Prices on American Pig Lead

Per pound

New York	4.50 to 5.50
Cleveland	4.75 to 5.00

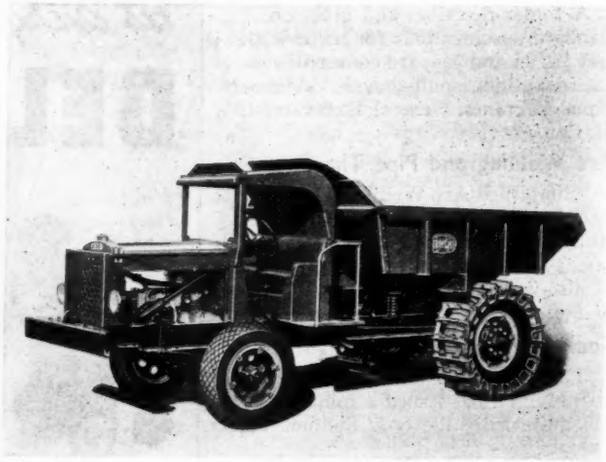


The Cletrac Diesel "35"



Trackson Tractor with Case Power

The Euclid Trac-Truk has super-balloon tires



"Truk" with Tire Tracks

What's New in Trucks and Tractors

Cletrac "35" Diesel:

The Cleveland Tractor Company announces the Cletrac 35 Diesel, which delivers a maximum of 46 horsepower at the drawbar. The engine is of the same general construction as the engine which has proven so satisfactory in the Cletrac Diesel 80, working under all kinds of conditions. Embodied in the Cletrac Diesel 35 are the features of the Cletrac 35 gasoline tractor which has been tried and proven by years of service in both agricultural and industrial work.

The Cletrac Diesel 35 engine is of six-cylinder design, 4⅜" bore by 5¼" stroke and operates at 1200 r.p.m. It has seven main bearings and the crankshaft is balanced with integral weights, resulting in a well-balanced, smooth operating engine. Removable liners are provided in the cylinder block.

A distinguishing characteristic of the Cletrac 35 Diesel is that it is equipped with electric starting which has proved so successful on the Cletrac Diesel 80. The Cletrac 35 Diesel is the first full diesel tractor in its power class to offer this convenient and money saving feature.

Rear Dump "Truk":

This is a heavy-duty haulage unit which provides power, speed and traction in a way and to a degree that they can be used with the greatest possible efficiency. Maximum power can be used in the softest ground; exceptionally short turning radius is provided. The body hoists nearly to the vertical, which cuts down unloading time. Traction is sure and positive. For longer hauls, dual pneumatic tires are available.

This unit is tough enough for the hardest work, quick and easy to control; sure footed, and with two supplementary foot operated steering brakes. It is made by the Euclid Road Machinery Co., Cleveland, O. Full information in a folder sent on request.

Heavy-Duty Industrial Tractor:

A new heavy-duty Trackson Crawler-Tractor, known as the Model GI-30, has just recently been put into production. It is specially designed to meet industrial requirements. It is the first crawler-tractor equipped with a directional transmission which provides equal agility in either direction of travel—three forward and three reverse speeds—a feature that sets new standards of efficiency on operations involving the use of auxiliary equipment, such as shovels, loaders, cranes, booms, etc.

The tractor weighs approximately 4 tons, is powered by the 1-30 McCormick-Deering motor and develops 30 drawbar horsepower. Besides the "directional transmission" it can be equipped with a transmission providing four forward and one reverse speeds.

The Manufacturers Say:

"The Euclid bottom dump Trac-Truk has a speed comparable to that of motor trucks—and has the carrying capacity of crawler tractor wagons. Six yards of pay dirt are carried at speeds ranging to fifteen miles an hour. Fully twice the yardage per hour is moved with no greater investment. *Operating costs — fuel — grease and oil — maintenance*—are reduced to levels heretofore impossible. Turning radius approximately 13 feet."

This promising unit, which employs large size, low pressure tires, is manufactured by Euclid Road Machinery Co., Cleveland, O.

on pipe line construction, weights, and dimensions. 40 pages, handy pocket size. United States Pipe & Foundry Co., Burlington, N. J.

Pipe Forms

409. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Taste and Odor Control

411. How, when and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Co., Inc., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

412. Cliff-Char, a Superior Activated Carbon, for Water Purification. Exceptionally high in phenol adsorption, deodorizing power, taste adsorption, clarifying power. Full information will be sent by Chemical Dept., The Cleveland-Cliffs Iron Co., Union Trust Building, Cleveland, Ohio.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Conditioning

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

Sludge Incineration

395. Guaranteed Odorless and Efficient Method of Sewage Sludge Drying and Incineration. Just announced. A new bulletin describing process now ready. Combustion Engineering Co., 200 Madison Ave., New York, N. Y.

Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., and Philadelphia.

Road and Street Maintenance

Asphalt Heaters

8. Full information concerning their tar and asphalt kettles, surface heaters, oil burners and other road maintenance equipment will be sent promptly on request by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Bituminous Materials

225. A comprehensive manual on the "Use of Emulsions for Street and Highway Construction and Maintenance," discussing types, uses, relative costs, construction details, etc., will be sent promptly on request by Headley Ashphalt Division, Sinclair Refining Co., P. O. Box 72, Marcus Hook, Penna.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy, 28-page booklet illustrating the many types of road surfaces which may be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texas Company, 135 East 42nd St., New York, N. Y.

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York, N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

Snow Removal

345. "Standard and Heavy Duty Reversible Blade Snow Plows for Motor Trucks," a new bulletin just published by the Monarch Mfg. Co., East Front St., Wilmington, Del. Illustrated. Contains complete descriptions and specifications.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

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For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Handy Information on Ferric Chloride:

This booklet is just what the name implies. It tells of practices and experiences in the handling and use of ferric chloride in water and sewage treatment. Specifications and characteristics of lump and solutions are given. There is lots of useful information on shipping, handling and storing; also procedures in making analyses; curves and tables; methods of dissolving lump ferric chloride. Your copy free on request to Innis, Speiden Co., 117 Liberty St., New York City.

Polyconic Projections:

In U. S. Coast & Geodetic Survey special publication No. 57, an attempt has been made to gather into one volume all the investigations that apply to the system of polyconic projections. No such treatise now exists in the English language. No adequate treatment even of American polyconic projections has been given in any separate publication. A long table of contents is given, but no data on number of pages. Twenty-five cents from Superintendent of Documents, Government Printing Office, Washington, D. C. Do not send stamps.

Cement Bound Macadam:

The first complete guide to design and construction of cement bound macadam has been issued by the Portland Cement Association, 33 West Grand Ave., Chicago, Ill. Contents include: Design recommendations, thickness, fine aggregate, coarse aggregate, grout, the flow cone, mixing water required, quantities for estimating (with examples), construction procedure, equipment, subgrade, spreading and compacting aggregate, grouting, etc. Two pages of pictures illustrate the steps in construction. complete specifications cover 8 pages. Sent on request.

How to Hire Welders:

This booklet outlines simple tests for measuring the ability of welders. Also contains other data of interest. 24 pages. Issued by the Linde Air Products Co., 30 East 42nd St., New York. An 8-page pamphlet on bronze welding is also issued by the same company.

Housing Bulletin:

The fourth of a series of bulletins by the Federal Housing Administration; it is prepared especially for manufacturers and advertising agencies. The first was for property owners, the second for local Better Housing Committees, and the third for architects, contractors and building supply dealers. Sent on request to the Editor or to the Federal Housing Administration, Washington, D. C.

Filtration and Filters for Industrial Use:

A sound and informative booklet just issued by the Filtration Equipment Corporation, 350 Madison Avenue, New York. Among the treatment types described are "rotary vacuum filters, bar screens and magnetite sand filters used in sewage treatment and water supply purification." The Filtration Equipment Corporation, well known in the field of

sewage treatment and disposal, also specializes in industrial filtration. An interesting feature of this new booklet is its make-up, including index tab, to fit the engineer's equipment file. This convenience of reference will be appreciated by the man who has experienced trouble in locating what he wants when he wants it. This booklet will be mailed free on request to anyone interested in the subject of filtration.

Asphalt Road-Mix Construction:

The third edition, revised, of Manual No. 1, Road-Mix Types, has been issued by the Asphalt Institute, 801 Second Ave., N. Y., and is available on request to the Editor of PUBLIC WORKS without charge. Sixty-two pages; illustrated fully. Contents: Types of road-mix construction; selection of appropriate type; conditioning the existing surface; labor, equipment and tools; construction details of graded aggregate course; construction details of macadam aggregate type; plant mixing; material tests and control of mixtures; service and cost of road-mix types. An excellent and valuable booklet; pocket size.

Waterproofing Concrete:

One of the more recent developments in the field of waterproofing is Stonhard Stontite, a liquid material which, it is said, stops leaks ranging from streams the size of the fist to occasional seepage. Any handy man can use Stonhard Stontite to waterproof foundations, walls, elevator pits, floors, tunnels, swimming pools, reservoirs, dams, aqueducts—in fact anything constructed of concrete. It is not necessary to remove the hydrostatic pressure—for this material is used on the free or open side of the structure. Complete information and specific recommendations for individual applications can be secured from the Stonhard Co., 401 North Broad Street, Philadelphia, Pa.

Aluminum Paint:

A 60-page booklet on aluminum paint is available, covering complete data on the subject. Chapters of interest to our readers include paints for water tanks; steel towers; state, county and municipal uses; poles and posts; and specifications for aluminum paint. Sent on request to the Editor, or to the Aluminum Co. of America, Pittsburgh, Pa.

Demolition:

Three important demolition jobs are described in a mimeographed pamphlet available from F. J. Byrne, du Pont Publicity Bureau, Wilmington, Del. The work involved the breaking up of the concrete and the cutting off of the piles (in some jobs) for concrete piers along southern New Jersey's coast.

Transits and Levels:

The seventh edition of the Warren-Knight catalog covering engineering and surveying instruments is available on request. Much interesting and valuable information. 64 pages. Write Warren-Knight Co., Philadelphia, Pa.

Sheet Piling:

Section details, corners and fabricated connections, splices, taper piles, wall lengths, circle diameters and standard classification of extras are covered in Catalog 3, just issued by the Inland Steel Co., 38 South Dearborn St., Chicago, Ill.

Telemetering for Waterworks

The Chronoflow telemetering system and its application to installations for transmission of flow, level, pressure and position for distances ranging from "hundreds of feet to hundreds of miles" with private wire circuits, or through leased telephone channels, is described in Bulletin 273, issued by Builders Iron Foundry, Providence, R. I. Sent on request.

Radio Control for Tractors:

The construction man or contractor who would like to be able to burn the ears off some of his tractor operators from time to time with aptly chosen words, may find some ideas in this booklet, which describes the radio tractor at the Century of Progress exposition. Sent on request by International Harvester Co., 606 So. Michigan Ave., Chicago, Ill.

Roll-A-Plane Rollers:

A complete description of the new Austin Roll-a-plane roller, features of its design and operation, illustrations showing how it attains unusual smoothness on highway surfaces, and other very complete information, are contained in a bulletin (No. 1351) just issued by the Austin-Western Road Machinery Co., Aurora, Ill.